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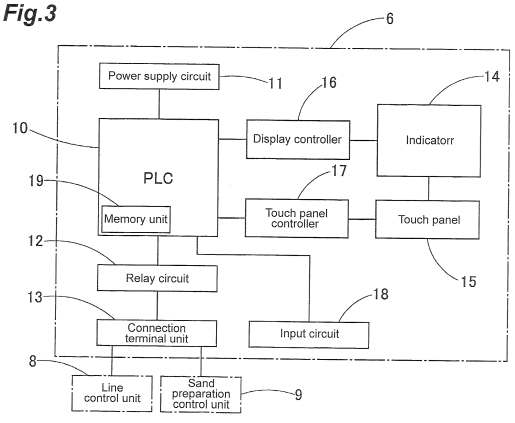
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(54) MOUNTING ASSIST DEVICE FOR MOLD-MAKING APPARATUS, AND MOLD-MAKING APPARATUS

(57) In a flaskless mold making apparatus 1 which causes electrical equipment, pneumatic equipment, and hydraulic equipment to operate by an operation of a control unit 10 included in a control panel 6, and makes a mold from molding sand, provided is an installation assist device for assisting installation thereof. The installation assist device includes a display 14 provided in the control panel 6, and for displaying characters, and a touch panel 15 for inputting a switch operation signal by an installation worker's operation. In the control unit 10, a storage unit 19 for previously storing information to display on the display 14 dialogically an installation procedure when installing the mold making apparatus 1 is provided. The control unit 10 performs control so as to display on the display 14 characters of the installation procedure read out of the storage unit 19, and proceed with installation procedures in order dialogically based on a switch input signal input from the touch panel 15.

Fig.3



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Description

Technical Field

[0001] The present invention relates to an installation assist device for a mold making apparatus and a mold making apparatus, and particularly, to an installation assist device for a mold making apparatus for assisting an installation worker, when installing a mold making apparatus at a part of an existing automatic mold transfer line or the like, to perform connection of signal lines with the transfer line side and setting of a control panel correctly without error, and a mold making apparatus using the same.

Background Art

[0002] In the case of a manufacturing line for manufacturing castings using sand molds, very large and heavy equipment including a mold making apparatus is installed on the line, molds are made from molding sand, and castings are mass-produced by using the molds. In such a manufacturing line, for example, when the mold making apparatus is installed at a part of an existing automatic mold transfer line or the like, it is necessary to perform piping connection with the automatic mold transfer line, connection of signal lines, setting of a control panel, etc., correctly without error. This type of mold making apparatus for making molds for molding castings has been known as in the following Patent Document 1 etc.

Citation List

Patent Literature

[0003] Patent Document 1: Japanese Patent Application Laid-Open No. H07-16705

Summary of Invention

Technical Problem

[0004] In recent years, this type of mold making apparatus has been exported from a country in which molding apparatuses are manufactured to factories around the world. When installing the mold making apparatus in a local factory, for performing piping connection with an automatic mold transfer line, connection of signal lines, setting of a control panel, etc., correctly without error, it is necessary to dispatch a skilled engineer to the site from the country where molding apparatuses have been manufactured and perform mounting and installation work.

[0005] However, the expense for dispatching skilled engineers to install the mold making apparatuses mounts. Because the number of skilled engineers is also limited, installation work of the mold making apparatuses at factories in countries of destinations for export may sometimes be performed by unskilled workers from the local factories. In this case, piping connection, connection of signal lines, setting of a control panel, etc., are likely to be erroneously performed during installation of the mold making apparatus. Therefore, correct installation may not be able to be performed, which is likely to hinder normal operation.

[0006] Moreover, combinations of mold transfer lines and sand preparation equipment in factories around the world are of great variety, such as automatic, semi-automatic, and manual combinations. Conventionally, operation programs have been customized according to their layouts. Furthermore, because skilled electrical process designers or engineers perform connection of signal lines, programming, or the like at the sites according to necessity, there is a problem such that the expense for dispatching skilled electrical process designers or engineers mounts.

[0007] Therefore, in the relevant technical field, an installation assist device for a mold making apparatus that allows performing installation work of a mold making apparatus easily and correctly has been demanded.

Solution to Problem

[0008] An installation assist device for a mold making apparatus according to an aspect of the present invention is an installation assist device for assisting installation of a mold making apparatus in the mold making apparatus which causes electrical equipment, pneumatic equipment, and hydraulic equipment to operate by an operation of a control unit included in a control panel, and makes a mold from molding sand, and characterized by including a display unit provided in the control panel, and for displaying characters, a switch operating unit for inputting a signal by an installation worker's operation, an installation procedure storage unit provided in the control unit, and for previously storing information to display on the display unit dialogically an installation procedure when installing the mold making apparatus, and an installation assist control unit that performs control so as to cause the display unit to display characters of the installation procedure by referring to the installation procedure storage unit, and so as to display installation procedures in order dialogically based on a switch input signal input from the switch operating unit.

[0009] According to this installation assist device, when installing a mold making apparatus in a factory or the like, even an installation worker without skills can operate the switch operating unit dialogically by referring to an installation procedure displayed on the display unit and confirm execution of installation work, while performing installation work such as piping connections and connection of signal lines of the mold making apparatus easily and correctly without error.

[0010] In an embodiment, the control unit may previously store language dictionary data in a plurality of languages including a foreign language so as to be selecta-

ble. Such an arrangement allows, when a mold making apparatus is installed in a foreign factory, performing installation assistance by displaying the installation procedure in that country's language.

[0011] In an embodiment, there may be an arrangement such that a display having a touch panel is mounted in the control panel as the display unit, so as to display on the display a button image of a completion button together with an installation procedure, such that when a corresponding site in the touch panel corresponding to the completion button is ON-operated, a signal indicating completion is input to the control unit, and so as to proceed to a next installation procedure screen display only when all completion buttons are ON-operated.

[0012] Such an arrangement allows an installation worker to operate the completion button or the like by using the touch panel by referring to the installation procedure displayed on the display unit and proceed with installation work dialogically in order so as to perform all required installation work efficiently.

[0013] In an embodiment, there may be an arrangement such that character information for detailed description of an installation procedure is stored in the installation procedure storage unit, so as to display on an assist screen of the display unit an image of a details button, and so as to display characters for detailed description of the installation procedure on the display unit when the details button is ON-operated.

[0014] Such an arrangement allows an installation worker, when the procedure of installation work is unknown, to ON-operate the details button on the display to cause a display of detailed description of the installation procedure, and refer to the same.

[0015] In an embodiment, character information concerning connection of a signal line to be connected between the control panel and a line control panel on a transfer line side is stored in the installation procedure storage unit, on an assist screen of the display unit, images of a use button and a non-use button may be displayed so as to enable selective display together with the character information, and when the non-use button is ON-operated, a setting processing associated with non-use of the signal line may be set and stored in a storage unit of the control unit.

[0016] Such an arrangement allows automatically changing and storing a setting of the control unit such as a processing, when, for example, equipment on the transfer line side operates manually and connection of a signal line to the line control panel is not necessary, for releasing interlock signals according thereto.

[0017] Moreover, even when there are a great variety of combinations of mold transfer lines and sand preparation equipment and there are operation programs customized according to their layouts, installation workers without skills can perform installation work simply and correctly, which allows a reduction in the expense for dispatching skilled electrical process designers or engineers.

[0018] Moreover, a mold making apparatus according to another aspect of the present invention includes upper and lower molding flasks consisting of an upper molding flask and a lower molding flask, a match plate being able to enter and exit between the upper and lower molding flasks, an upper squeeze member and a lower squeeze member for forming an upper molding space and a lower molding space as a result of being located at respective opening portions of the upper and lower molding flasks sandwiching the match plate, and a sand tank for filling the upper molding space and the lower molding space with sand.

Advantageous Effects of Invention

[0019] According to the various aspects and embodiment of the present invention, during installation of a mold making apparatus, installation work such as piping connections, connection of signal lines, and setting of a control panel can be performed easily and correctly without error.

Brief Description of Drawings

[0020]

Fig. 1 is a front view of a flaskless mold making apparatus according to an embodiment.

Fig. 2 is a side view of the same flaskless mold making apparatus.

Fig. 3 is a configuration block diagram of a control panel.

Fig. 4 is an explanatory view for explaining the operation of the flaskless mold making apparatus, and is a view showing a state in which a pattern shuttle-in step has ended in a mold manufacturing process.

Fig. 5 is a side view showing a state of the flaskless mold making apparatus in which an aeration step has ended.

Fig. 6 is a side view showing a state in which a squeeze step has ended.

Fig. 7 is a side view showing a state in which a pattern shuttle-out step has ended.

Fig. 8 is a side view showing a state in which a flask separation step has ended.

Fig. 9 is a connection diagram showing a connection state between a connection terminal unit of a control panel and a line control unit and a sand preparation control unit.

Fig. 10 is a ladder diagram of an installation assist program.

Fig. 11 is a ladder diagram of an installation assist program.

Fig. 12 is a flowchart showing the operation of an installation assist processing.

Fig. 13 includes explanatory views of installation assist display screens. Fig. 13(a) is a screen example of "Introduction." Fig. 13(b) is a screen example of

molding apparatus leveling. Fig. 13(c) is a screen example of piping connections.

Fig. 14 includes explanatory views of installation assist display screens. Fig. 14(a) is a screen example of sand feed hopper mounting. Fig. 14(b) is a screen example of filling of hydraulic fluid etc.

Fig. 15 includes explanatory views of installation assist display screens. Fig. 15(a) is a screen example of connection of signal lines. Fig. 15(b) is an example of a specific description about connection of a signal line. Fig. 15(c) is an operation example of the screen shown in Fig. 15(a).

Fig. 16 includes explanatory views of installation assist display screens. Fig. 16(a) is an example of a screen of compliance matters. Fig. 16(b) is an example of a screen of compliance matters, which is a screen showing a case where all have been completed.

Description of Embodiments

[0021] Hereinafter, an embodiment of an installation assist device for a mold making apparatus of the present invention will be described based on the drawings by taking a flaskless mold making apparatus as an example. The installation assist device is for assistance in installation of a mold making apparatus. This installation implies not only newly installing a mold making apparatus but also installation when relocating a mold making apparatus once installed. Further, the installation assist device can also be used when altering or when replacing a transfer line and sand preparation equipment as peripheral equipment of a mold making apparatus.

[0022] First, the flaskless mold making apparatus 1 serving as a mold making apparatus is, as shown in Fig. 1 to Fig. 5, schematically, constructed including a mold making section 2 for making a mold consisting of an upper mold and a lower mold, a lower flask advance/retract drive section 3 for causing a lower flask 33 to enter into and retract from the mold making section 2, a mold ejector section 4 for ejecting a mold made by the mold making section 2 to the outside, and a molding sand feeding section 5 for feeding the mold making section 2 with molding sand.

[0023] The flaskless mold making apparatus 1, as shown in Fig. 1 to Fig. 4, includes a gate type frame 21 as a basic frame. The gate type frame 21 is constructed by integrally connecting a lower base frame 22 and an upper base frame 23 via two pairs of columns 27 disposed at four corners when viewed on a plane.

[0024] At a central portion of an upper surface of the lower base frame 22, a flask-set and squeeze cylinder 24 is attached facing up. At the tip of a piston rod 24a of the flask-set and squeeze cylinder 24, a lower squeeze board 26 is attached via an upper end portion of a lower squeeze frame 25. A main body portion of the flask-set and squeeze cylinder 24 is inserted through a through-hole provided in the center of a lower end portion of the lower squeeze frame 25. At four corners when viewed on a plane of the lower base frame 22, slide bushings (not shown) having heights of at least 10mm or more are provided, so that a horizontal state of the lower squeeze frame 25 is maintained.

[0025] At the lower end portion of the lower squeeze frame 25, four lower filling frame cylinders 28 are attached in a vertical state so as to surround the flask-set and squeeze cylinder 24. A piston rod 28a at the upper side of each lower filling frame cylinder 28 passes through a through-hole provided in the lower end portion of the lower squeeze frame 25, and has a lower filling frame 29 attached at its tip.

[0026] An inner surface of the lower filling frame 29 is formed so as to be narrowed as it goes downward, and formed so that the lower squeeze board 26 can maintain an airtight condition while being fitted therein. In a sidewall portion of the lower filling frame 29, a molding sand inlet 29c is provided. At an upper surface of the lower filling frame 29, a positioning pin 29d is provided in a standing condition.

[0027] At the tip of the piston rod 24a of the flask-set and squeeze cylinder 24, the lower squeeze board (lower squeeze member) 26 is attached via the upper end portion of the lower squeeze frame 25. At the lower end portion of the lower squeeze frame 25, the lower filling frame cylinders 28 are attached. At the tips of the piston rods 28a at the upper side of the lower filling frame cylinders 28, the lower filling frame 29 is attached.

[0028] Therefore, when the piston rod 24a of the flask-set and squeeze cylinder 24 performs an extending or contracting operation, simultaneously therewith, the lower squeeze board 26, the lower squeeze frame 25, the lower filling frame cylinders 28, and the lower filling frame 29 rise or fall as one body. Moreover, there is an arrangement such that the lower filling frame 29 rises or falls when the piston rods 28a at the upper side of the lower filling frame cylinders 28 perform an extending or retracting operation.

[0029] On a lower surface of the upper base frame 23, an upper squeeze board (upper squeeze member) 30 is provided in a fixed manner, and the upper squeeze board 30 is at an opposing position above the lower squeeze board 26. On the upper base frame 23, an upper flask cylinder 31 formed of an air cylinder is provided in a manner fixed facing down. At the tip of the piston rod 31a of the upper flask cylinder 31, an upper flask 32 is attached.

[0030] An inner surface 32a of the upper flask 32 is formed so as to be widened as it goes downward, and formed so that the upper squeeze board 30 can maintain an airtight condition while being fitted therein. As shown in Fig. 4 etc., in a sidewall portion 32b of the upper flask 32, a molding sand inlet 32c is provided.

[0031] At an intermediate position between the upper squeeze board 30 and the lower squeeze board 26, a space S into which the lower flask 33 to be described later can enter and in which the entered lower flask 33 becomes movable up and down is formed. At the inside

of the columns 27, a pair of traveling rails 34 that extend in parallel in the left-right direction (the left-right direction means the left-right direction in Fig. 1, and the same applies in the following) on an identical horizontal plane are arranged.

[0032] The lower flask advance/retract drive section 3 is disposed on the left side or right side (in Fig. 1, the left side) of the columns 27. The lower flask advance/retract drive section 3 includes a pattern shuttle cylinder 35 disposed facing right, and at the tip of a piston rod 35a of the pattern shuttle cylinder 35, a master plate 36 is attached in a horizontal state. The master plate 36 is attached at the tip of the piston rod 35a so as to be able to separate upward from the tip of the piston rod 35a.

[0033] At a lower surface of the master plate 36, the lower flask 33 is attached. At an upper surface of the master plate 36, a match plate 37 including patterns at its upper and lower surfaces is attached. The master plate 36 includes roller arms 36a that are in a vertical state at four corners when viewed on a plane, respectively. At the upper end and lower end of each roller arm 36a, flanged rollers 36b, 36c are arranged, respectively.

[0034] The four lower flanged rollers 36c are arranged so as to be, when the piston rod 35a of the pattern shuttle cylinder 35 is in a retracted state, on the pair of guide rails 38 extending in parallel in the left-right direction on an identical horizontal plane so as to be movable by rolling, and when the above-described piston rod 35a comes into an advancing state, separate from the pair of guide rails 38, and move to the inside of the columns 27.

[0035] Of the four upper flanged rollers 36b, only two right flanged rollers 36b are on a left end portion of the pair of traveling rails 34 extending from the columns 27 when the piston rod 35a of the pattern shuttle cylinder 35 is in a retracted state, and when the above-described piston rod 35a comes into an advancing state, two left flanged rollers 36b are also placed on the pair of traveling rails 34.

[0036] The mold ejector section 4 is, as shown in Fig. 1, disposed on the left side of the columns 27. The mold ejector section 4 includes a mold ejector cylinder 39 disposed facing right. At the tip of a piston rod 39a of the mold ejector cylinder 39, an ejector plate 40 is connected.

[0037] The molding sand feeding section 5 is arranged on a side surface of the upper base frame 23. The molding sand feeding section 5 is constructed including a molding sand feed port 41, a sand gate 42 for opening and closing the molding sand feed port 41, and an aeration tank 43 disposed under the sand gate 42. The aeration tank 43 is a sand tank provided at its inner surface with a filter member having a large number of air jet holes for jetting air, and capable of jetting air at a pressure of approximately 0.05 to 0.18MPa while performing sand filling. As shown in Fig. 4 etc., the tip of the aeration tank 43 branches off in a bifurcated manner in the up-down direction to form sand inlets 43a.

[0038] The control panel 6 for controlling the operation of the flaskless mold making apparatus 1 is, as shown in Fig. 3, constructed having a control unit 10 formed of a PLC (Programmable Logic Controller) as a main unit, and by providing a display (display unit) 14 with a touch panel 15 at the front of a housing. In the control unit 10, a storage unit 19 such as a flash memory for storing control program data including previously stored installation assist program data etc., is provided, and a control processing of the molding apparatus including installation assist display control is executed based on these program data. Therefore, the control unit 10 is connected with a power supply circuit 11 for supplying a predetermined voltage of power supply, a relay circuit 12 serving as an input/output circuit, etc., besides the display 14 with the touch panel 15. The above-described installation procedure storage unit is composed of the storage unit 19 of the control unit 10, and the above-described installation assist control unit is composed of the control unit 10. The power supply circuit 11 can be input with an alternating input voltage of up to, for example, 100V to 240V so as to be compatible with various foreign power supply voltages and the like.

[0039] The connection terminal unit 13 connected to the relay circuit 12 is connected with signal lines to various electrical equipment etc., such as solenoid valves for controlling pneumatic equipment or hydraulic equipment, and also has signal lines connected with a line control unit 8 on the side of a transfer line and a sand preparation control unit 9 for feeding molding sand in the following. That is, a mold ejection completion signal and a molding machine out-of-interference signal are output (generated) from the control unit 10 of the flaskless mold making apparatus 1 to the line control unit 8, and therefore, as shown in Fig. 3, a relay contact circuit is connected from the connection terminal unit 13 to the line control unit 8. Moreover, a mold ejection enable signal and a line out-of-interference signal are output (generated) from the line control unit 8 to the control panel 6, and a signal line therefor is connected between the connection terminal unit 13 and the line control unit 8.

[0040] Further, a sand measurement signal is output from the control panel 6 of the flaskless mold making apparatus to the sand preparation control unit 9, and therefore, a relay contact circuit is connected from the connection terminal unit 13 to the sand preparation control unit 9.

[0041] Further, in the control panel 6, an input circuit 18 for taking into control unit 10 detection signals of sensors such as a pressure sensor, and a temperature sensor to be used for the flaskless mold making apparatus is provided, and connected to the control unit 10.

[0042] The display 14 is composed of, for example, an LCD (liquid crystal display with a backlight) with a touch panel, and a display controller 16 for controlling a display is connected between the display 14 and the control unit 10. Moreover, a touch panel controller 17 is connected between the touch panel 15 and the control unit 10 to input to the control unit 10 an input signal (switch input signal) due to contact of the touch panel 15 that is

equipped on a display surface of the display 14. The display 14, for which language data (language dictionary data) in respective languages is provided in a storage unit such as a flash memory in the display in order to display by characters a plurality of foreign languages besides Japanese, is structured so that a character language to be displayed on the display 14 can be selected therefrom by an installation worker. In addition, this language data may be provided in the storage unit 19 that can be referred to. Moreover, for the display 14, an EL display or the like can also be used besides an LCD, and for the touch panel 15 to serve as an input operating unit (switch operating unit), another key switch or the like can also be used.

[0043] The control unit 10 formed of a PLC stores previously prepared control program data for executing the operation of the flaskless mold making apparatus 1 as in the following, that is, a series of steps of a pattern shuttle-in step, a flask setting step, an aeration step, a squeeze step, a draw step, a pattern shuttle-out step, a flask matching step, a flask removal step, a flask separation step, and a mold ejection step, in order. Moreover, program data for an installation assist device of an embodiment to be described later is previously stored in this control unit 10.

[0044] In addition, as control panels of the flaskless mold making apparatus 1, a plurality of control panels may be provided in addition to the control panel 6 in Fig. 1, and in that case, the control unit, display, etc., of an installation assist device can be provided on a control panel other than the control panel 6 in Fig. 1 as long as it is a control panel that controls the operation of the flaskless mold making apparatus 1, or there can be an arrangement of the foregoing and following plurality of functions provided separately on the plurality of control panels.

[0045] For the control unit 10 formed of a PLC, program data for installation assist is prepared by use of a ladder diagram, and the program data is written therein. A program for installation assist prepared by use of a ladder diagram, as shown in Fig. 10, first, on rung 1, stores an introduction screen display K1 so as to display an initial screen for assistance of "Introduction" on the display 14 when the control panel 6 is powered on, and has an installation completion memory bit M8b provided on rung 1 so as not to display the initial screen for assistance after installation is completed.

[0046] Further, on rung 2, a leveling completion memory bit M11 and a fixing completion memory bit M12 are provided so as to store first section work completion M1 when leveling and fixing of the molding apparatus are completed and "completion buttons" indicating those are ON-operated. On rung 3, a main piping completion memory bit M21, a receiver tank piping completion memory bit M22, an aeration tank piping completion memory bit M23, and an air dryer mounting completion memory bit M24 are provided so as to store second section work completion when connections of pressure air piping are completed and "completion buttons" indicating those are ON-operated.

[0047] On rung 4, it is programmed so as to store fourth section work completion M3 when mounting of a sand feed hopper is completed, a centering adjustment of the sand feed port is completed, and a "completion buttons" indicating those are ON-operated. Further, on rung 5, a hydraulic fluid completion memory bit M41, a release agent completion memory bit M42, a grease completion memory bit M43, and a Master oil wipe-away completion memory bit 44 are provided so as to store fourth section work completion M4 when filling of hydraulic fluid, a release agent, and grease is completed, wiping-away of Master oil is completed, and "completion buttons" indicating those are ON-operated. In addition, the display operation in line with rungs 2 to 5 is arranged so as to display a screen to confirm respective installation operations on the display 14 and proceed to the next rung (next screen) only when all "completion buttons" displayed on the screen are ON-operated.

[0048] Further, on rung 6, it is programmed so as to store fifth section work completion M5 when "use" or "non-use" is determined regarding a mold ejection completion signal connection, a molding apparatus out-of-interference signal connection, a mold ejection enable signal connection, a line out-of-interference signal connection, and a sand measurement signal connection and "completion buttons" are ON-operated. Specifically, first, 5-1 is completed as a result of performing a mold ejection completion signal connection as well as the "completion button" being ON-operated by selecting "use" or as a result of the "completion button" being ON-operated by selecting "non-use" when no mold ejection completion signal connection is performed. Here, selecting "use" means that a "completion button" is pushed in such a state as shown in Fig. 15(a), and selecting "non-use" means that a button indicated as "use" is indicated as "non-use" as shown in Fig. 15(c) as a result of the button indicated as "use" being pushed in such a state as shown in Fig. 15(a), and a "completion button" is pushed in such a state as shown in Fig. 15(c). Moreover, there may be an arrangement so as to cause selection by simultaneously displaying both of a "use button" and a "non-use button" and having either to be pushed. Then, 5-2 is completed as a result of performing a molding apparatus out-of-interference signal connection as well as the "completion button" being ON-operated by selecting "use" or as a result of the "completion button" being ON-operated by selecting "non-use" when no molding apparatus out-of-interference signal connection is performed. There is programming on rung 6 so as to store M5 as mentioned above when, similar to the mold ejection completion signal connection of "5-1" and the molding apparatus out-of-interference signal connection of "5-2," connection and selection of use or selection of non-use and an ON-operation of the "completion button" are then performed also for each of the mold ejection enable signal connection of "5-3," the line out-of-interference signal connection

of "5-4," and the sand measurement signal connection of "5-5."

[0049] Further, in the operation in line with rung 6, it is programmed as shown on rung 7 in Fig. 11 so as to display a "use button" and a "non-use button" together with the "completion button" on the display 14 corresponding to each signal connection, and when the "non-use button" is ON-operated and non-use of a specific signal connection is input, release interlock for the relevant signal to bypass an interface signal. Accordingly, when an input operation for setting a line out-of-interference signal as non-use is performed, non-use of a line out-of-interference signal M6 is set and stored.

[0050] That is, it is programmed so as to provide, on rung 7, a b-contact of a line out-of-interference non-use memory bit M60 to set a line out-of-interference signal as non-use and a line out-of-interference completion memory bit M61 to set a line out-of-interference signal as completed, provide an a-contact of the line out-of-interference completion memory bit M61 in parallel with the line out-of-interference non-use memory bit M60, and provide a memory bit M6a of the line out-of-interference non-use M6 in parallel with the b-contact of the line out-of-interference completion memory bit M61.

[0051] Accordingly, for example, when the transfer line side has a manually operating structure and a line out-of-interference signal is not used, because the line out-of-inference non-use memory bit M60 is turned on and the line out-of-interference completion memory bit M61 is off at this time, the line out-of-interference signal non-use M6 is stored, and self-retained, with turning on of the line out-of-interference completion memory bit M61, by the memory bit M6a of the line out-of-interference non-use M6.

[0052] Further, it is programmed so as to provide, on rung 8, a contact X2 that is turned on at a falling end of the flask-set and squeeze cylinder 24, a contact X3 that is turned on at a falling end of the lower filling frame cylinders 28, a contact (out-of-interference contact) X4 that is turned on when an out-of-interference signal on the transfer line side is received, and a memory bit M6a of line out-of-interference signal non-use M6 in parallel with the out-of-interference contact X4. Accordingly, it is programmed so that, when a line out-of-interference signal is not used, on rung 7, the line out-of-interference signal non-use M6 is stored and retained, and irrespective of an operation of the out-of-interference contact X4 on the transfer line side, the bit M6a of the line out-of-interference signal non-use M6 is turned on, and interlock release of mold ejection M7 holds when the flask-set and squeeze cylinder 24 reaches the falling end and the lower filling frame cylinders 28 reaches the falling end. When a mold ejection enable signal is used, mold ejection is executed, in a state where the interlock release M7 has held in automatic operation (in normal operation), when the mold ejection enable signal is received from the line side. Moreover, when a mold ejection enable signal is not used, mold ejection is executed at a point in time where the interlock release M7 holds in automatic operation. Although a specific description has been given for rung 8 by using 5-2 as an example of the operation of setting and storage in Fig. 15 in the following, the same setting and storage is performed as a result of use or non-use being selected also for 5-1, 5-3, 5-4, and 5-5 in Fig. 15.

[0053] Further, it is programmed so as to provide respective, on rung 9, memory bits M1a to M5a of the above-described first section work completion M1 to fifth section work completion M5, further provide a b-contact of a memory bit M90 when set memory is cleared, and so that when all memory bits M1a to M5a are on and the memory bit M90 is off, installation completion M8 is stored, and that memory is self-retained by a memory bit M8a connected in parallel with the memory bits M1a to M5a. When the memory bit M90 is turned on, the memory set in the above is cleared. This memory bit M90 is displayed as a "clear button" on a screen or the like in, for example, Fig. 13, used when returning the apparatus settings into an initial state, and turned on in the case of alteration or extension on the line side.

[0054] Next, the operation of a flaskless mold making apparatus having the above-described arrangement will be briefly described. The flaskless mold making apparatus operates, under control of the control panel 6, so as to perform a series of steps of the pattern shuttle-in step, flask setting step, aeration step, squeeze step, draw step, pattern shuttle-out step, flask matching step, flask removal step, flask separation step, and mold ejection step in order as in the following.

(1) At start (Fig. 1)

[0055] In the mold making section 2, the piston rod 24a of the flask-set and squeeze cylinder 24 is located at a retracting end, and the lower squeeze board 26 is located at a falling end. Moreover, the piston rods 28a at the upper side of the lower filling frame cylinders 28 are located at a retracting end, and the lower filling frame 29 is located at a falling end. Moreover, the piston rod 31a of the upper flask cylinder 31 is located at an advancing end, and the upper flask 32 is located at a falling end.

[0056] In the lower flask advance/retract drive section 3, the piston rod 35a of the pattern shuttle cylinder 35 is located at a retracting end, and the master plate 36, the lower flask 33, and the match plate 37 are located at retracting ends, respectively. In the mold ejector section 4, the piston rod 39a of the mold ejector cylinder 39 is located at a retracting end, and the ejector plate 40 is located at a retracting end. In the molding sand feeding section 5, molding sand 51 (Fig. 5) is filled in the aeration tank 43.

(2) Pattern shuttle-in step (Fig. 2, Fig. 7)

[0057] The piston rod 35a of the pattern shuttle cylinder 35 is advanced. Due to the advance of the piston rod

35a, the master plate 36 advances, two left flanged rollers 36b out of the four upper flanged rollers 36b come to be placed on the pair of traveling rails 34 and the four lower flanged rollers 36c on the pair of guide rails 38 come to be separated therefrom, and when the piston rod 35a has advanced to an advancing end, the master plate 36, the lower flask 33, and the match plate 37 are set at predetermined positions inside of the columns 27 of the mold making section 2.

(3) Flask setting step (Fig. 8)

[0058] The piston rod 24a of the flask-set and squeeze cylinder 24 is advanced to cause the lower squeeze board 26 to rise, and the lower filling frame cylinders 28 are advanced to cause the lower filling frame 29 to rise, insert the positioning pins 29d of the lower filling frame 29 through positioning holes (not shown) in the lower flask 33, and overlap the lower filling frame 29 with a lower surface of the lower flask 33, so as to form a lower mold space (lower molding space) enclosed by the lower squeeze board 26, the lower filling frame 29, the lower flask 33, and the match plate 37. Here, because the lower squeeze board 26 and the lower squeeze frame 25 are integrated, when the flask-set and squeeze cylinder 24 is caused to rise or fall, the lower squeeze frame 25 also rises or falls together with the lower squeeze board 26.

[0059] Next, these are integrally raised to insert the positioning pins 29d through a lower surface of the upper flask 32, and overlap the lower flask 33 with the lower surface of the upper flask 32 via the match plate 37 and the master plate 36, so as to form an upper mold space (upper molding space) enclosed by the upper squeeze board 30, the upper flask 32, and the match plate 37.

[0060] Here, when the upper mold space is formed, the piston rod 24a of the flask-set and squeeze cylinder 24 has not yet reached an advancing end (rising end). When the upper mold space is formed, the position of the molding sand inlet 29c in the lower filling frame 29 is coincident with the position of the sand inlet 43 a in the aeration tank 43.

[0061] Although Fig. 8 shows a state in which the molding sand 51 is filled in the upper mold space and lower mold space, the flask setting step is a state before the molding sand 51 is filled.

(4) Aeration step

[0062] In the molding sand feeding section 5, the sand gate 42 (Fig. 2) is closed, and compressed air is fed to the aeration tank 43. The molding sand 51 in the aeration tank 43, due to the air pressure of the compressed air, is introduced into the lower mold space through the lower sand inlet 43a and the molding sand inlet 29c in the lower filling frame 29 and introduced into the upper mold space through the upper sand inlet 43a and the molding sand feed inlet 32c in the upper flask 32. In this aeration step, only the compressed air is discharged to the outside from outlets (not shown) mounted in sidewall portions of the upper flask 32 and the lower flask 33.

(5) Squeeze step (Fig. 6)

[0063] The piston rod 24a of the flask-set and squeeze cylinder 24 is further advanced, and molding sand 52 in the upper mold space and molding sand 53 in the lower mold space are compressed and squeezed by the upper squeeze board 30 and the lower squeeze board 26. In this squeeze step, with a rise of the lower squeeze board 26, the lower filling frame 29, the lower flask 33, the match plate 37, and the upper flask 32 rise. By this squeeze step S4, an upper mold 54 and a lower mold 55 are formed.

(6) Draw (pattern draw) step

[0064] The piston rod 24a of the flask-set and squeeze cylinder 24 is retracted, and the lower squeeze board 26 is caused to fall. With the fall of the lower squeeze board 26, the lower flask 33, the match plate 37, the master plate 36, and the lower filling frame 29 also fall. In the process of falling, the four upper flanged rollers 36b of the master plate 36 are placed on the pair of traveling rails 34, the master plate 36, the lower flask 33, and the match plate 37 stop falling, and the lower squeeze board 26 and the lower filling frame 29 continue falling.

(7) Pattern shuttle-out step

[0065] When the four upper flanged rollers 26b of the master plate 36 are placed on the pair of traveling rails 34 in the draw step, the master plate 36 reaches a state of being connected to the tip of the piston rod 35a of the pattern shuttle cylinder 35.

[0066] In the pattern shuttle-out step, the piston rod 35a of the pattern shuttle cylinder 35 is retracted to the retracting end. Due to the retraction of the piston rod 35a, the four lower flanged rollers 36b of the master plate 36 are placed on the pair of guide rails 38 and two left flanged rollers 36b out of the four upper flanged rollers 36b of the master plate 36 on the pair of traveling rails 34 are separated therefrom, and the master plate 36, the lower flask 33, and the match plate 37 return to the retracting ends (original positions).

[0067] After this pattern shuttle-out step ends, it becomes possible to set a core inside of the columns 27, and core setting is performed according to necessity.

(8) Flask matching step

[0068] When the piston rod 24a of the flask-set and squeeze cylinder 24 is advanced to raise the lower squeeze board 26, and brings the lower mold 55 into contact with a lower surface of the upper mold 54. An advancing output of the flask-set and squeeze cylinder 24 at this time is set so as to be smaller than an advancing

output in the squeeze step and so as not to crush the upper mold 54 and the lower mold 55.

(9) Flask removal step

[0069] The piston rod 31a of the upper flask cylinder 31 is retracted, and the upper flask 32 is caused to rise. Due to the rise of the upper flask 32, the upper mold 54 is removed from the upper flask 32. After the removal, the piston rod 31 a of the upper flask cylinder 31 is advanced to return the upper flask 32 to the falling end (original position).

(10) Flask separation step

[0070] The piston rod 24a of the flask-set and squeeze cylinder 24 is retracted, and the lower squeeze board 26 is caused to return to the falling end (original position). Moreover, the piston rods 28a at the upper side of the lower filling frame cylinders 28 are retracted, and the lower filling frame 29 is returned to the falling end (original position).

(11) Mold ejection step.

[0071] The piston rod 39a of the mold ejector cylinder 39 is advanced to advance the ejector plate 40, and send out the molds (the upper mold 54 and the lower mold 55) on the lower squeeze board 26 to the transfer line.

(12) About sand supply

[0072] Concerning sand supply, the following two methods can be considered. The first method is a method of detecting being empty, and is a method to be performed separately from the series of steps (1) to (11) in the above. This first method is not a method for performing sand supply to an aeration tank every time, but a method in which sand supply is performed when a sensor (not shown) has detected that sand in the aeration tank 43 is less than a predetermined amount. The second method is a method of detecting being full, and for performing sand supply to an aeration tank every time in conjunction with the series of steps (1) to (11) in the above. The second method is a method in which sand supply is performed until a sensor (not shown) detects that sand in the aeration tank 43 exceeds a predetermined amount. The second method is, for making the whole apparatus small, effective particularly when the tank capacity is approximately 1.3 times to 3.0 times the amount of sand to be used in one time of mold making. Here, description will be specifically given assuming that the second method is carried out. In the case of sand supply, the control panel 6 transmits a sand measurement signal based on detection by a sensor (not shown) to the line control unit 8 on the transfer line side, and requests the line side to fill up sand. The sand measurement signal is, for example, transmitted in, for example, a draw step after an aeration step. The control panel 6 continues transmitting a sand measurement signal until a sensor (not shown) detects exceeding a threshold to indicate being nearly full. In response to this signal, sand is supplied to the aeration tank 43 on the line side. Moreover, this sand measurement signal is transmitted also when the apparatus is operated for the first time, and the aeration tank 43 is fed with sand.

[0073] Next, the operation of an installation assist device to be used when mounting (including mounting in the case of relocation) the flaskless mold making apparatus 1 in a factory or the like will be described. As shown in the flowchart of Fig. 12, the flaskless mold making apparatus 1 is mounted at a predetermined position, and in step 100, the control panel 6 of the flaskless mold making apparatus 1 is powered on. Accordingly, as shown in Fig. 13(a), the screen of "Introduction" is displayed on the display 14. An installation worker sets a language of characters to be displayed on this screen (step 110).

[0074] Because this installation assist device allows selecting a displaying language from languages including a plurality of foreign languages, when the flaskless mold making apparatus 1 is exported to a foreign country, a local installation worker can set a local language so as to bring the device into an easily understandable state. In addition, the setting input operation is performed by operating the touch panel 15 on a display screen. Then, to a question "Have you thoroughly read the safety precautions for installation?" displayed on the screen, a "yes button" displayed on the screen is ON-operated via the touch panel 15, and when a "next button" displayed on the screen is further turned on, a next screen of molding apparatus leveling is displayed as in Fig. 13 (b). Following this display, the installation worker performs horizontal leveling of the flaskless mold making apparatus 1 (step 120). This horizontal leveling is performed by turning an adjusting bolt provided in a projecting condition on a bottom portion of a base of the flaskless mold making apparatus 1, and the bolt is locked in a horizontal state for fixing.

[0075] In the screen of molding apparatus leveling, items of molding apparatus leveling and fixing of the molding apparatus are displayed together with "details buttons" and "completion buttons" as shown in Fig. 13 (b). When the "details buttons" are ON-operated, specific descriptions (detailed description) about the molding apparatus leveling and fixing of the molding apparatus are displayed on the screen. Here, the "ON-operation" is an operation, on a touch panel where an image corresponding to a completion button or the like is displayed, by an installation worker selecting the corresponding site. Then, when the installation worker finishes the work of molding apparatus leveling and fixing of the molding apparatus, the displayed "completion button" is ON-operated, and a "next button" is turned on, a next piping connection screen is displayed as in Fig. 13(c).

[0076] In this piping connection screen, respective items of a connection of main air piping, a piping connec-

tion from the molding apparatus to a receiver tank, a piping connection from a receiver tank to an aeration tank, and a piping connection to an air drier machine are displayed together with "details buttons" and "completion buttons." Following this display, the installation worker performs a connection of pressure air piping in the factory and piping of the molding apparatus, a piping connection from the molding apparatus to a receiver tank, and a piping connection from a receiver tank to an aeration tank (step 130).

[0077] At this time, when the "details buttons" for connection of air piping are ON-operated, specific descriptions about those piping connections are displayed. Then, when the installation worker finishes the work of those piping connections, all of the "completion buttons" are ON-operated, and a "next button" is turned on, a next screen of sand feed hopper mounting is displayed on the display 14 as in Fig. 14(a).

[0078] In the screen of sand feed hopper mounting, an item of sand feed hopper mounting and a centering adjustment of the sand feed hopper and molding apparatus are displayed together with "details buttons" and "completion buttons." Following this display, the installation worker mounts a sand feed hopper (not shown) above the molding sand feed port 41, and performs a centering adjustment of that sand feed hopper and the molding apparatus (step 140). At this time, when the "details buttons" are ON-operated by the installation worker, specific descriptions about the mounting and centering of the sand feed hopper are displayed on the display 14. Then, when the installation worker finishes the work of mounting and centering of the sand feed hopper, the "completion buttons" for both of the mounting and centering are ON-operated, and a "next button" is turned on, a next screen of filling of hydraulic fluid etc., is displayed as in Fig. 14(b).

[0079] In the screen of filling of hydraulic fluid etc., an item of hydraulic fluid filling, an item of release agent filling, an item of grease injection, and an item of Master oil wipe-away are displayed together with "details buttons" and "completion buttons." Following this display, the installation worker fills an oil tank with a hydraulic fluid, fills a release agent tank with a release agent, and injects grease into a greasing site (step 150), and further, wipes away Master oil applied to the apparatus surface for rust prevention when being transported (step 160). At this time, when the "details button" is ON-operated, a specific description about the hydraulic fluid filling, release agent filling, grease injection, or Master oil wipe-away is displayed.

[0080] Then, when the installation worker finishes the work of hydraulic fluid filling, release agent filling, grease injection, and Master oil wipe-away, all of the "completion buttons" are ON-operated, and a "next button" is turned on, a next screen of connection of signal lines is displayed as in Fig. 15(a).

[0081] In the screen of connection of signal lines, each of the item of (5-1) connection of a signal line for sending a mold ejection completion signal from the control panel 6 of the molding apparatus to the line control unit 8 of the transfer line, item (5-2) of connection of a signal line for sending a molding apparatus out-of-interference signal from the control panel 6 of the molding apparatus to the line control unit 8 of the transfer line, item (5-3) of connection of a signal line for sending a mold ejection enable signal from the line control unit 8 of the transfer line to the control panel 6 of the molding apparatus, item (5-4) of connection of a signal line for sending a line side out-of-interference signal from the line control unit 8 of the transfer line to the control panel 6 of the molding apparatus, and item (5-5) of connection of a signal line for sending a sand measurement signal from the control panel 6 of the molding apparatus to a control panel of the sand preparation equipment is displayed together with a "details button," a "use/non-use button," and a "completion button."

[0082] Here, for example, when the "details button" is ON-operated in item (5-1) of a signal line of a mold ejection completion signal, a specific description about the connection of a signal line of a mold ejection completion signal is displayed as shown in Fig. 15(b). Moreover, when the transfer line to which a mold is ejected operates manually, and does not use a molding apparatus out-of-interference signal and its signal line, the "use button" in item (5-2) is ON-operated to set that item as "non-use" as in Fig. 15(c).

[0083] At this time, in the control unit 10 of the control panel 6, setting and storage is performed so as to release interlock by a molding apparatus out-of-interference signal internally. Moreover, when the transfer line to which a mold is ejected operates manually, and does not use a line side out-of-interference signal and its signal line, the "use button" in item (5-4) is ON-operated to set that item as "non-use" as in Fig. 15(c). At this time, in the control unit 10 of the control panel 6, setting and storage is performed so as to release interlock by a line side out-of-interference signal internally.

[0084] That is, the installation worker, in item (5-1) on the screen shown in Fig. 15(c), when a signal line for sending a mold ejection completion signal to the line control unit 8 of the transfer line is used, as shown in Fig. 9, performs work to connect between the connection terminal unit 13 and the line control unit 8 a signal line T1 connecting relay contacts in series, and keeps the "use" in item (5-1) as it is while ON-operating the "completion button." At this time, the control unit 10 proceeds from step 170 to step 180 in Fig. 12, for setting so as to validate a mold ejection completion signal. On the other hand, when a mold ejection completion signal to be output from the control unit 10 to the line control unit 8 of the transfer line is not used, the installation worker ON-operates the "use button" in item (5-1) to change that item into "non-use," and ON-operates the "completion button." Accordingly, the control unit 10 directly proceeds from step 170 to step 190.

[0085] Next, the installation worker, in item (5-2), when

a signal line for sending a molding machine out-of-interference signal to the line control unit 8 of the transfer line is used, as shown in Fig. 9, performs work to connect between the connection terminal unit 13 and the line control unit 8 a signal line T2 connecting relay contacts in series, and keeps the "use" in item (5-2) as it is while ON-operating the "completion button." At this time, the control unit 10 proceeds from step 190 to step 195 in Fig. 12, for setting so as to validate a molding machine out-of-interference signal. On the other hand, for example, when the transfer line has a manually operating structure and connection of its signal line is not necessary, the installation worker ON-operates the "use button" in item (5-2) to be changed into "non-use," and ON-operates the "completion button." At this time, the control unit 10 proceeds from step 190 to step 200 in Fig. 12.

[0086] Next, the installation worker, in item (5-3), when a signal line for sending a mold ejection enable signal to the control unit 10 from the line control unit 8 of the transfer line is used, as shown in Fig. 9, performs work to connect between the connection terminal unit 13 and the line control unit 8 a signal line T3 connecting relay contacts in series at the side of the line control unit 8, and keeps the "use" in item (5-3) as it is while ON-operating the "completion button." At this time, the control unit 10 proceeds from step 200 to step 210 in Fig. 12, for setting so as to validate a mold ejection enable signal. On the other hand, for example, when the transfer line has a manually operating structure and connection of a signal line of a mold ejection enable signal is not necessary, the installation worker ON-operates the "use button" in item (5-3) to be changed into "non-use," and ON-operates the "completion button." At this time, the control unit 10 proceeds from step 200 to step 220 in Fig. 12.

[0087] Next, the installation worker, in item (5-4), when a signal line for sending a line out-of-interference signal to the control unit 10 from the line control unit 8 of the transfer line is used, as shown in Fig. 9, performs work to connect between the connection terminal unit 13 and the line control unit 8 a signal line T4 connecting relay contacts in series at the side of the line control unit 8, and keeps the "use" in item (5-4) as it is while ON-operating the "completion button."

[0088] At this time, the control unit 10 proceeds from step 220 to step 230 in Fig. 12, for setting so as to validate a line out-of-interference signal. On the other hand, for example, when the transfer line has a manually operating structure and connection of a signal line of a line out-of-interference signal is not necessary, the installation worker ON-operates the "use button" in item (5-4) to be changed into "non-use," and ON-operates the "completion button." At this time, the control unit 10 proceeds from step 220 to step 240 in Fig. 12.

[0089] Next, the installation worker, in item (5-5), when a signal line for sending a sand measurement signal to the sand preparation control unit 9 of the sand preparation equipment from the control unit 10 is used, as shown in Fig. 9, performs work to connect a signal line T5 with a relay contact connected in series between the connection terminal unit 13 and the sand preparation control unit 9, and keeps the "use" in item (5-5) as it is while ON-operating the "completion button."

[0090] At this time, the control unit 10 proceeds from step 240 to step 250 in Fig. 12, for setting so as to validate a sand measurement signal. On the other hand, when connection of a signal line of a sand measurement signal is not necessary, the installation worker ON-operates the "use button" in item (5-5) to be changed into "non-use," and ON-operates the "completion button." Then, when all "completion buttons" on the screen of wiring connection in Fig. 15 are ON-operated and a "next button" is ON-operated, on the display 14, a screen of compliance matters as in Fig. 16(a) is displayed.

[0091] Then, when the installation operator thoroughly reads the displayed compliance matters, then ON-operates a "yes button," and further ON-operates a "yes button" to a question whether being a pattern in a shape in line with technical manual specifications in item (6-2), 6. "Completed" is lit and displayed. In this state, as shown in Fig. 16(b), when the installation worker ON-operates an 4'all-completion button," the control unit 10 proceeds from step 260 to step 270 in Fig. 12, and installation of the molding apparatus is completed.

[0092] Thus, when installation of a flaskless mold making apparatus is performed, an installation assist screen is displayed on the display 14. On the screen, necessary installation work items are displayed in order together with "completion buttons" etc. When an installation worker reads the work item, performs the work, and ON-operates the "completion button," a next work item is displayed. When all of the installation work is completed, the installation assist screen ends. In the case of performing installation of a flaskless mold making apparatus in a foreign factory without a skilled installation worker, even a local ordinary worker can read the installation work items while performing installation of the molding apparatus correctly without error or omission.

[0093] Moreover, with regard to connection of a signal line between the control unit 10 and the line control unit 8 and the connection of a signal line between the control unit 10 and the sand preparation control unit 9 described above, there is an arrangement to allow selective setting by an installation worker ON-operating the button of "use/non-use" on the screen. For example, when the transfer line side operates manually and there is no line control panel, it suffices for an installation worker to perform an operation so as to set the signal line of a molding machine out-of-interference signal and the signal line of a line out-of-interference signal as non-use. In the control unit 10, the setting is easily changed so that the operation of the molding apparatus is performed with the interlock of a molding machine out-of-interference signal and a line out-of-interference signal released.

[0094] The mold making apparatus 1 including such an installation assist device as above allows proceeding with installation work dialogically by the installation assist

device displaying character information concerning an installation procedure and connection etc., of various signal lines, displaying button images of details buttons, use buttons/non-use buttons, and completion buttons, causing selection of use or non-use of the various signal lines. Therefore, the mold making apparatus 1 realizes performing the installation work easily and correctly without error.

[0095] Moreover, in the mold making apparatus 1, which includes a mold ejector section 4 for ejecting a mold after mold making to the transfer line, the control unit 10 functions as a mold ejection enable signal receiving unit for receiving a mold ejection enable signal ("5-3" in Fig. 15) sent from a control unit of the transfer line. The mold making apparatus 1 causes selection of use or non-use of the mold ejection enable signal by the installation assist device. The installation assist device, when use is selected, sets and stores a setting to include receiving of the mold ejection enable signal by the mold ejection enable signal receiving unit in the storage unit 19 of the control unit 10 as a drive enable condition for the mold ejector section 4. On the other hand, the installation assist device, when non-use is selected, sets and stores a setting to exclude receiving of the mold ejection enable signal as a drive enable condition for the mold ejector section 4 in the storage unit 19 of the control unit 10. Due to such a characteristic arrangement, the mold making apparatus 1 allows easily performing cumbersome setting work during installation that has been necessary because of being an apparatus for performing a characteristic step of mold ejection, and allows correctly performing the same without the need for an installation instructor as conventionally required. Further, the mold making apparatus 1 enables a setting to cause mold ejection to be performed with appropriate timing.

[0096] Moreover, in the mold making apparatus 1, the control unit 10 functions as a mold ejection completion signal outputting unit for transmitting a mold ejection completion signal ("5-1" in Fig. 15) to a control unit of the transfer line. The mold making apparatus 1 causes selection of use or non-use of the mold ejection completion signal by the installation assist device. The installation assist device, when use is selected, sets and stores a setting to output the mold ejection completion signal from the mold ejection completion signal outputting unit when a mold ejection operation by the mold ejector section 4 is completed in the storage unit 19 of the control unit 10. On the other hand, the installation assist device, when non-use is selected, sets and stores a setting to exclude output of the mold ejection completion signal from the mold ejection completion signal outputting unit when a mold ejection operation by the mold ejector section 4 is completed in the storage unit 19 of the control unit 10. Due to such a characteristic arrangement, the mold making apparatus 1 allows easily performing cumbersome setting work during installation that has been necessary because of being an apparatus for performing a characteristic step of mold ejection, and allows correctly performing the same without the need for an installation instructor as conventionally required. Further, the mold making apparatus 1 improves the efficiency of the whole equipment by appropriately reporting mold ejection completion to the transfer line side.

[0097] Moreover, in the mold making apparatus 1, the control unit 10 functions as a line out-of-interference signal receiving unit for receiving a line out-of-interference signal ("5-4" in Fig. 15) sent from a control unit of the transfer line and indicating that the mold making apparatus is out of interference of the transfer line. The mold making apparatus 1 causes selection of use or non-use of the line out-of-interference signal by the installation assist device. The installation assist device, when use is selected, sets and stores a setting to include receiving of the line out-of-interference signal by the line out-of-interference signal receiving unit in the storage unit 19 of the control unit 10 as a drive enable condition for the mold ejector section 4. On the other hand, the installation assist device, when the non-use is selected, sets and stores a setting to exclude receiving of the line out-of-interference signal as a drive enable condition for the mold ejector section 4 in the storage unit 19 of the control unit 10. Due to such a characteristic arrangement, the mold making apparatus 1 allows easily performing cumbersome setting work during installation that has been necessary when setting an interlock, in an apparatus for performing a characteristic step of mold ejection, to prevent the occurrence of a defect due to interference with the line in this step, and allows correctly performing the same without the need for an installation instructor as conventionally required. Hence, the mold making apparatus 1 enables simply performing a setting for driving the apparatus safely to realize an appropriate molding operation.

[0098] Moreover, the mold making apparatus 1 includes a flask-set and squeeze cylinder 24 for driving the lower squeeze board 26, lower filling frame cylinders 28 for driving the lower filling frame 29, a cylinder falling end signal outputting unit for outputting a signal at the falling end of the flask-set and squeeze cylinder 24, and an lower filling frame falling end signal outputting unit for outputting a signal at the falling end of the lower filling frame cylinders 28. When use of one or both of the mold ejection enable signal and line out-of-interference signal is selected, the cylinder falling end signal and the lower filling frame falling end signal are additionally set and stored as an AND drive condition for enabling driving of the mold ejector section 4. On the other hand, when non-use of the mold ejection enable signal is selected and non-use of the line out-of-interference signal is selected, only the cylinder falling end signal and the lower filling frame falling end signal are set and stored as a drive enable condition for the mold ejector mechanism. Due to such a characteristic arrangement, the mold making apparatus 1 realizes performing mold ejection in an appropriate and safe state without the need for complicated setting work.

[0099] Moreover, the mold making apparatus 1 in-

cludes a sand tank (aeration tank 43) for filling a molding space with sand, a sand amount detection sensor (not shown) for detecting the amount of sand in the sand tank, and a sand gate 42 for opening and closing a sand supply port of the sand tank, and the control unit 10 functions as a sand measurement signal outputting unit for sending a sand measurement signal ("5-5" in Fig. 15) indicating that the sand tank requires a sand supply to a control unit of the sand preparation equipment. The mold making apparatus 1 causes selection of use or non-use of the sand measurement signal by the installation assist device. The installation assist device, when use is selected, sets and stores a setting to output the sand measurement signal from the sand measurement signal outputting unit when the sand gate 42 is in an open state and it has been detected by a sand amount detection sensor that sand supply is required in the storage unit 19 of the control unit 10. On the other hand, the mold making apparatus 1, when the non-use is selected, sets and stores a setting to exclude output of the sand measurement signal from the sand measurement signal outputting unit in the storage unit 19 of the control unit 10. Due to such a characteristic arrangement, the mold making apparatus 1 allows easily performing cumbersome setting work during installation that has been necessary because of being an apparatus that requires sand supply to a sand tank, and allows correctly performing the same without the need for an installation instructor as conventionally required. Further, the mold making apparatus 1 allows performing sand supply to the sand tank with appropriate timing, and thus enables performing mold making continuously.

[0100] Although a description has been given in the above-described embodiment of an example in which an installation assist device according to an embodiment is applied to a flaskless mold making apparatus, an installation assist device according to an embodiment can also be applied to a tight-flask molding machine having another structure and the like.

Preference Signs List

[0101] 1: flaskless mold making apparatus, 2: mold making section, 3: lower flask advance/retract drive section, 4: mold ejector section, 5: molding sand feeding section, 6: control panel, 8: line control unit, 9: sand preparation control unit, 10: control unit, 11: power supply circuit, 12: relay circuit, 13: connection terminal unit, 14: display, 15: touch panel, 16: display controller, 17: touch panel controller, 18: input circuit, 19: storage unit, 21: gate type frame, 22: lower base frame, 23: upper base frame, 24: flask-set and squeeze cylinder, 25: lower squeeze frame, 26: lower squeeze board, 27: column, 28: lower filling frame cylinder, 29: lower filling frame, 30: upper squeeze board, 31: upper flask cylinder, 32: upper flask, 33: lower flask, 34: traveling rail, 35: pattern shuttle cylinder, 36: master plate, 37: match plate, 38: guide rail, 39: mold ejector cylinder, 40: ejector plate, 41: molding sand feed port, 42: sand gate, 43: aeration tank.

Claims

1. An installation assist device for assisting installation of a mold making apparatus in the mold making apparatus which causes electrical equipment, pneumatic equipment, and hydraulic equipment to operate by an operation of a control unit included in a control panel, and makes a mold from molding sand, the installation assist device for a mold making apparatus comprising:

   a display unit provided in the control panel, and for displaying characters;
   a switch operating unit for inputting a signal by an installation worker's operation;
   an installation procedure storage unit provided in the control unit, and for previously storing information to display on the display unit dialogically an installation procedure when installing the mold making apparatus; and
   an installation assist control unit that performs control so as to cause the display unit to display characters of the installation procedure by referring to the installation procedure storage unit, and so as to display installation procedures in order dialogically based on a switch input signal input from the switch operating unit.

2. The installation assist device for a mold making apparatus according to claim 1, wherein the control unit previously stores language dictionary data in a plurality of languages including a foreign language so as to be selectable.

3. The installation assist device for a mold making apparatus according to claim 1, arranged such that a display having a touch panel is mounted in the control panel as the display unit, so as to display on the display a button image of a completion button together with an installation procedure, such that when a corresponding site in the touch panel corresponding to the completion button is ON-operated, a signal indicating completion is input to the control unit, and so as to proceed to a next installation procedure screen display only when all completion buttons are ON-operated.

4. The installation assist device for a mold making apparatus according to claim 1, arranged such that character information for detailed description of an installation procedure is stored in the installation procedure storage unit, so as to display on an assist screen of the display unit an image of a details button, and so as to display characters for detailed description of the installation procedure on the display unit when the details button is ON-operated.

5. The installation assist device for a mold making ap-

paratus according to claim 1, wherein character information concerning connection of a signal line to be connected between the control panel and a line control panel on a transfer line side is stored in the installation procedure storage unit, on an assist screen of the display unit, images of a use button and a non-use button are displayed so as to enable selective display together with the character information, and when the non-use button is ON-operated, a setting processing associated with non-use of the signal line is set and stored in a storage unit of the control unit.

6. The installation assist device for a mold making apparatus according to claim 1, wherein in the mold making apparatus, a mold ejector mechanism for ejecting a mold after mold making to a transfer line that is outside of the mold making apparatus is provided,
in the control unit, a mold ejection enable signal receiving unit for receiving a mold ejection enable signal sent from a control unit of the transfer line and indicating that it is a state in which mold ejection by the mold ejector mechanism is available is provided,
character information concerning connection of a signal line for a mold ejection enable signal to be connected between the control panel and a line control panel on a transfer line side is stored in the installation procedure storage unit, and on an assist screen of the display unit, an image that allows selecting use or non-use of the mold ejection enable signal is displayed together with the character information,
when the use is selected, a setting to include receiving of the mold ejection enable signal by the mold ejection enable signal receiving unit is set and stored in a storage unit of the control unit as a drive enable condition for the mold ejector mechanism, and
when the non-use is selected, a setting to exclude receiving of the mold ejection enable signal as a drive enable condition for the mold ejector mechanism is set and stored in the storage unit of the control unit.

7. The installation assist device for a mold making apparatus according to claim 6, wherein in the control unit, a mold ejection completion signal outputting unit for sending a mold ejection completion signal indicating that mold ejection by the mold ejector mechanism is completed to the control unit of the transfer line is provided,
character information concerning connection of a signal line for a mold ejection completion signal to be connected between the control panel and the line control panel on a transfer line side is stored in the installation procedure storage unit, and on the assist screen of the display unit, an image that allows selecting use or non-use of the mold ejection completion signal is displayed together with the character information,
when the use is selected, a setting to output the mold ejection completion signal from the mold ejection completion signal outputting unit when a mold ejection operation by the mold ejector mechanism is completed is set and stored in the storage unit of the control unit, and
when the non-use is selected, a setting to exclude output of the mold ejection completion signal from the mold ejection completion signal outputting unit when a mold ejection operation by the mold ejector mechanism is completed is set and stored in the storage unit of the control unit.

8. The installation assist device for a mold making apparatus according to claim 6, wherein in the mold making apparatus, a flask-set and squeeze cylinder for driving a lower squeeze member and a lower filling frame cylinder for driving a lower filling frame are provided, and
a cylinder falling end signal outputting unit for outputting a cylinder falling end signal at a falling end of the flask-set and squeeze cylinder and a flask falling end signal outputting unit for outputting a flask falling end signal at a falling end of the lower filling frame cylinder are provided,
when use of the mold ejection enable signal is selected, the cylinder falling end signal and the flask falling end signal are additionally set and stored as an AND drive condition for enabling driving of the mold ejector mechanism, and
when non-use of the mold ejection enable signal is selected, only the cylinder falling end signal and the flask falling end signal are set and stored as a drive enable condition for the mold ejector mechanism.

9. The installation assist device for a mold making apparatus according to claim 6, wherein in the control unit, a line out-of-interference signal receiving unit for receiving an out-of-interference signal sent from the control unit of the transfer line and indicating that the mold making apparatus is out of interference of the transfer line is provided,
character information concerning connection of a signal line for a line out-of-interference signal to be connected between the control panel and the line control panel on a transfer line side is stored in the installation procedure storage unit, and on the assist screen of the display unit, an image that allows selecting use or non-use of the line out-of-interference signal is displayed together with the character information,
when the use is selected, a setting to include receiving of the line out-of-interference signal by the line out-of-interference signal receiving unit is set and stored in the storage unit of the control unit as a drive enable condition for the mold ejector mechanism, and

when the non-use is selected, a setting to exclude receiving of the line out-of-interference signal as a drive enable condition for the mold ejector mechanism is set and stored in the storage unit of the control unit.

10. The installation assist device for a mold making apparatus according to claim 9, wherein in the mold making apparatus, a flask-set and squeeze cylinder for driving a lower squeeze member and a lower filling frame cylinder for driving a lower filling frame are provided, and
a cylinder falling end signal outputting unit for outputting a cylinder falling end signal at a falling end of the flask-set and squeeze cylinder and a flask falling end signal outputting unit for outputting a flask falling end signal at a falling end of the lower filling frame cylinder are provided,
when use of one or both of the mold ejection enable signal and the line out-of-interference signal is selected, the cylinder falling end signal and the flask falling end signal are additionally set and stored as an AND drive condition for enabling driving of the mold ejector mechanism, and
when non-use of the mold ejection enable signal is selected and non-use of the line out-of-interference signal is selected, only the cylinder falling end signal and the flask falling end signal are set and stored as a drive enable condition for the mold ejector mechanism.

11. The installation assist device for a mold making apparatus according to claim 6, wherein in the mold making apparatus, a sand tank for filling a molding space with sand,
a sand amount detection sensor for detecting the amount of sand in the sand tank, and
a sand gate for opening and closing a sand supply port of the sand tank are provided,
in the control unit, a sand measurement signal outputting unit for sending a sand measurement signal indicating that the sand tank requires a sand supply to a control unit of sand preparation equipment is provided,
character information concerning connection of a signal line for the sand measurement signal to be connected between the control panel and a control panel of the sand preparation equipment is stored in the installation procedure storage unit, and on the assist screen of the display unit, an image that allows selecting use or non-use of the sand measurement signal is displayed together with the character information,
when use is selected, a setting to output the sand measurement signal from the sand measurement signal outputting unit when the sand gate is in an open state and it has been detected by the sand amount detection sensor that sand supply is required is set and stored in the storage unit of the control unit, and
when non-use is selected, a setting to exclude output of the sand measurement signal from the sand measurement signal outputting unit is set and stored in the storage unit of the control unit.

12. A mold making apparatus comprising:

the installation assist device according to any one of claim 1 to claim 11;
upper and lower molding flasks consisting of an upper molding flask and a lower molding flask;
a match plate being able to enter and exit between the upper and lower molding flasks;
an upper squeeze member and a lower squeeze member for forming an upper molding space and a lower molding space as a result of being located at respective opening portions of the upper and lower molding flasks sandwiching the match plate; and
a sand tank for filling the upper molding space and the lower molding space with sand.

Fig.1

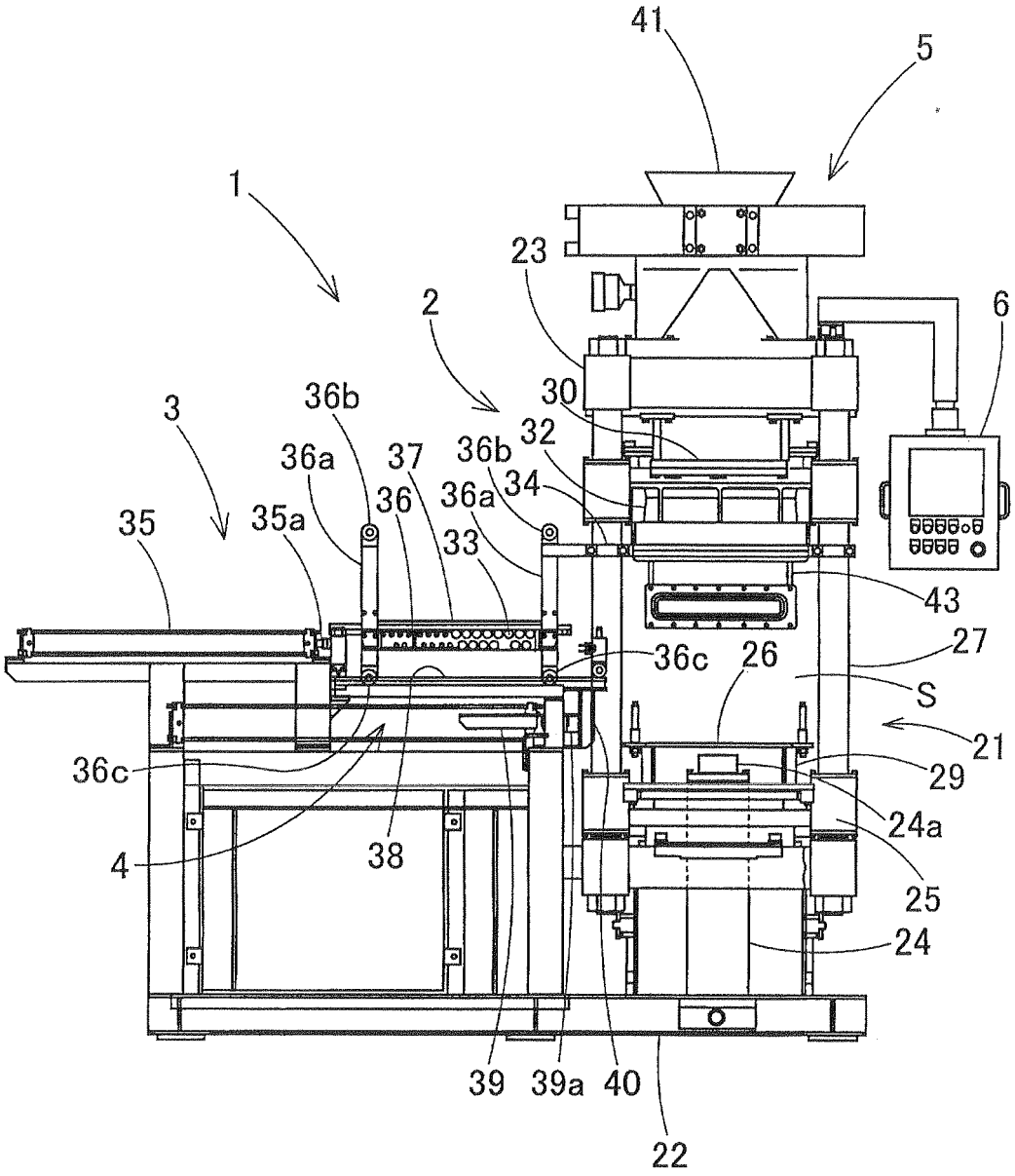

41
5
1
23
2
6
30
3
36b
32
36a
37
36b
34
36
36a
35
35a
33
43
27
36c
26
S
21
36c
29
24a
4
38
25
24
39
39a
40
22

Fig.2

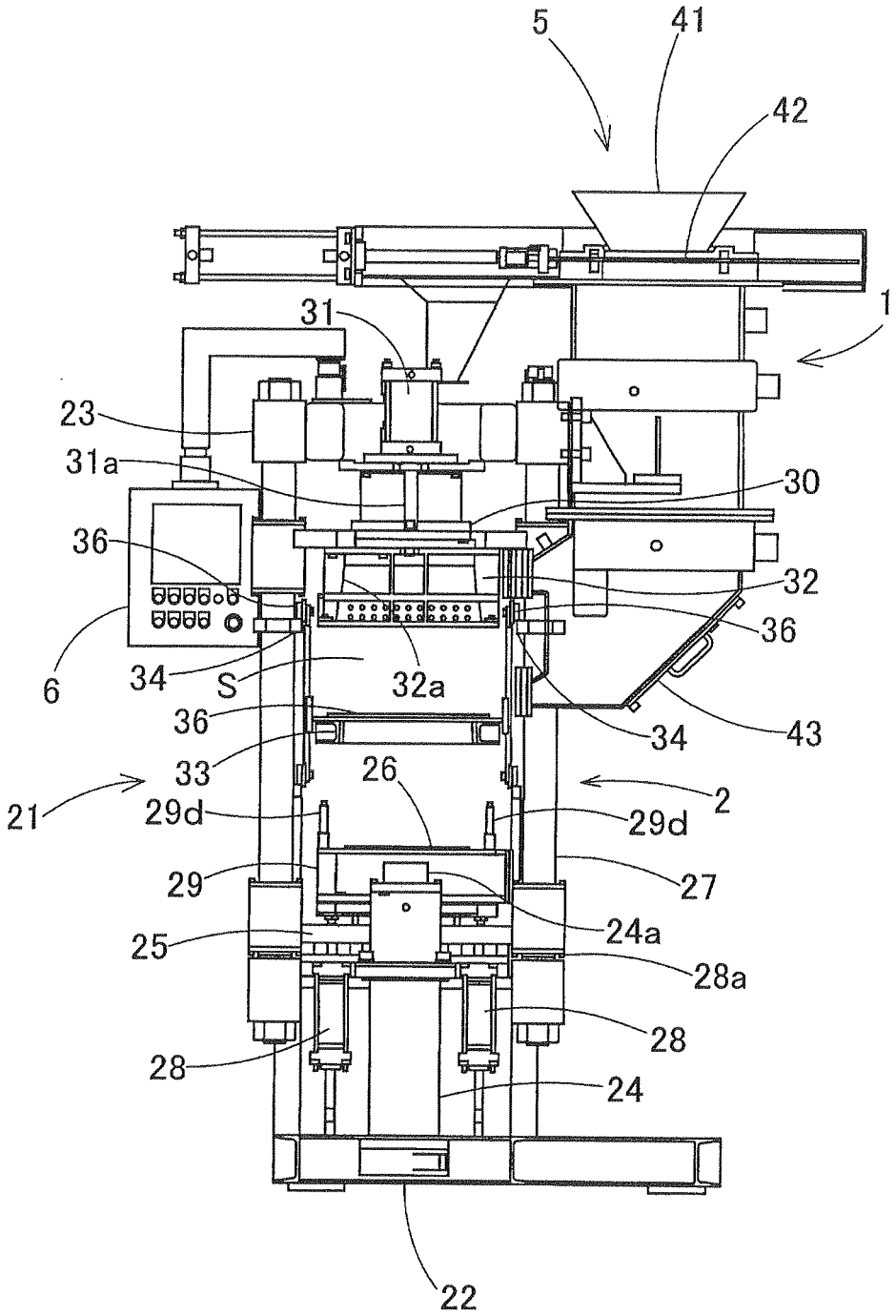

5
41
42
1
31
23
31a
30
36
32
36
6
34
S
32a
36
34
43
33
26
21
29d
29d
2
29
27
24a
25
28a
28
28
24
22

Fig.3

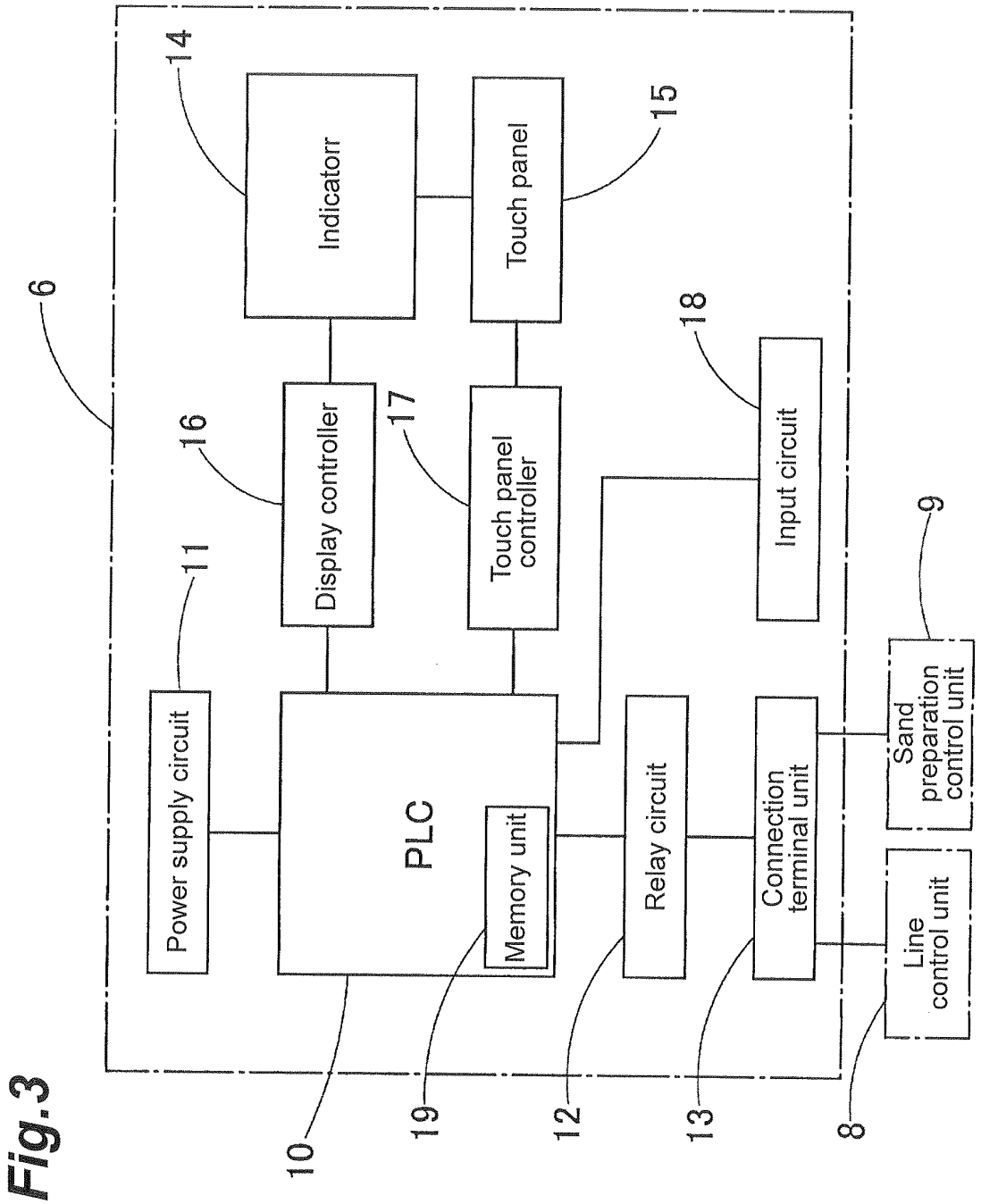

6
14
Indicatorr
15
Touch panel
18
16
Display controller
17
Touch panel controller
Input circuit
11
9
Power supply circuit
PLC
Memory unit
Relay circuit
Connection terminal unit
Sand preparation control unit
Line control unit
10
19
12
13
8

Fig.4

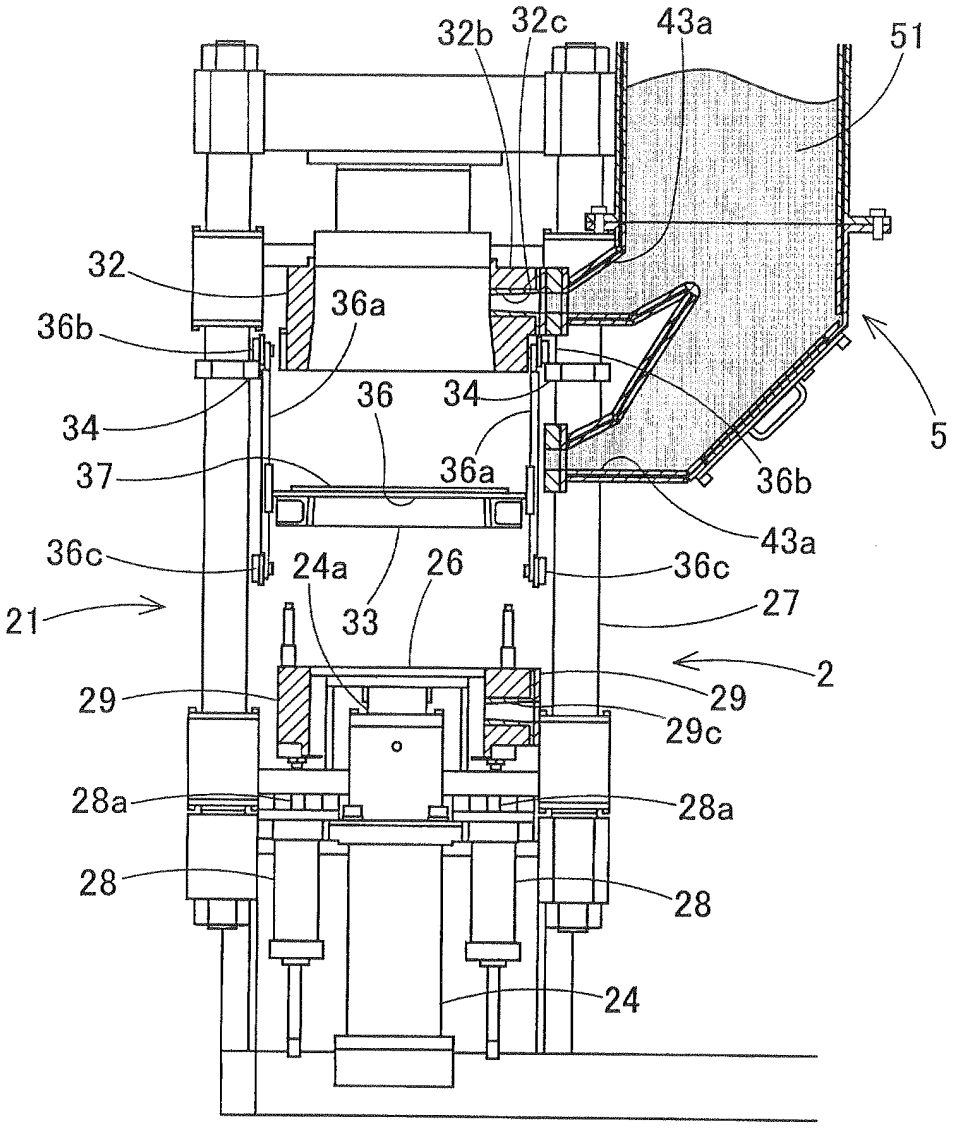

32b
32c
43a
51
32
36a
36b
36
34
34
5
37
36a
36b
43a
36c
24a
26
36c
21
33
27
2
29
29
29c
28a
28a
28
28
24

Fig.5

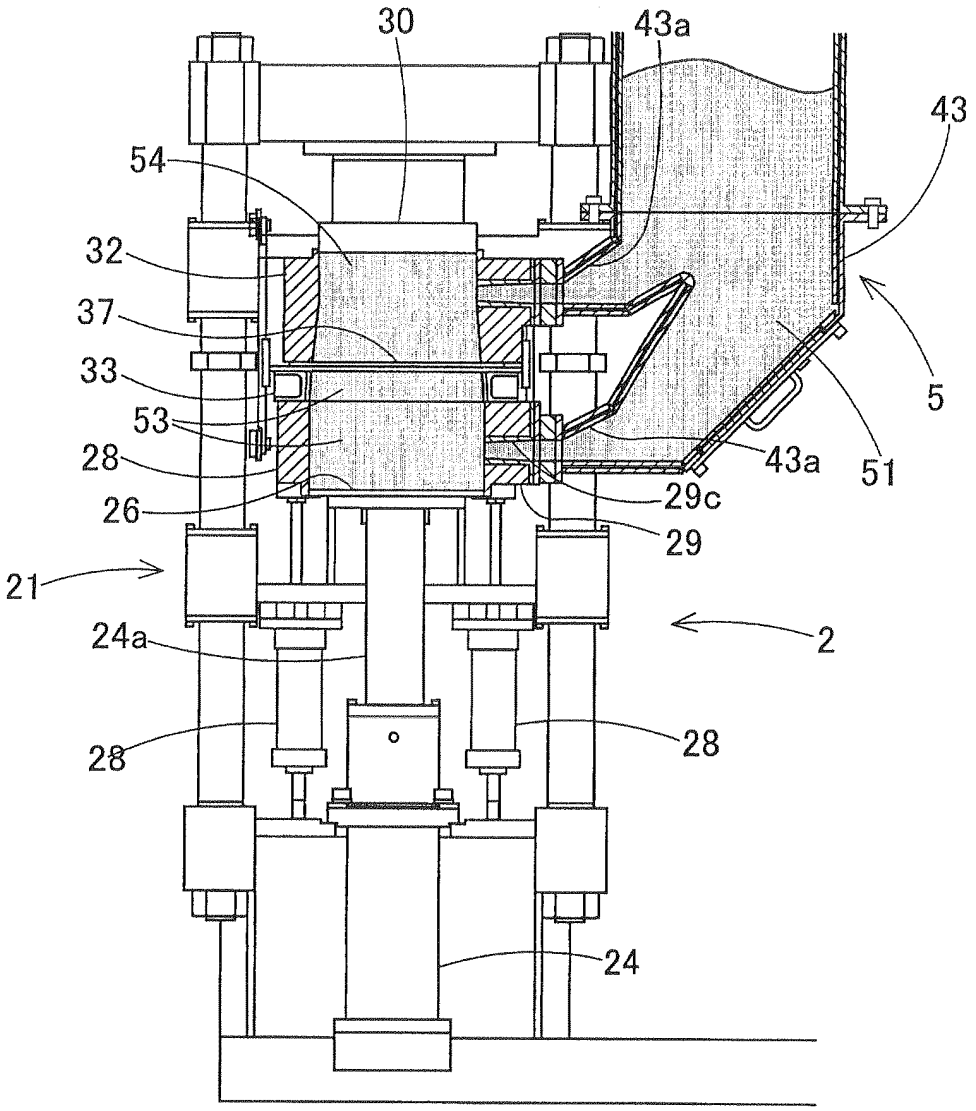


Fig.6

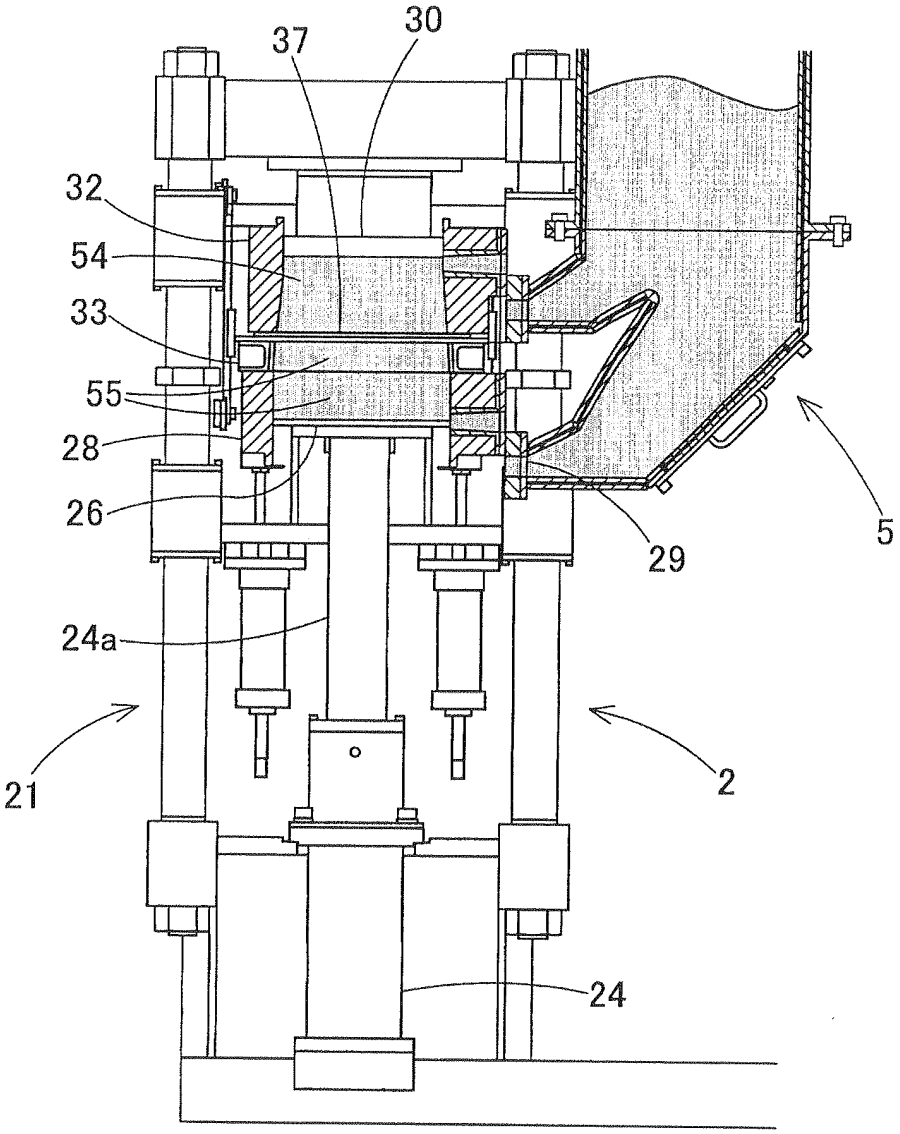


Fig.7

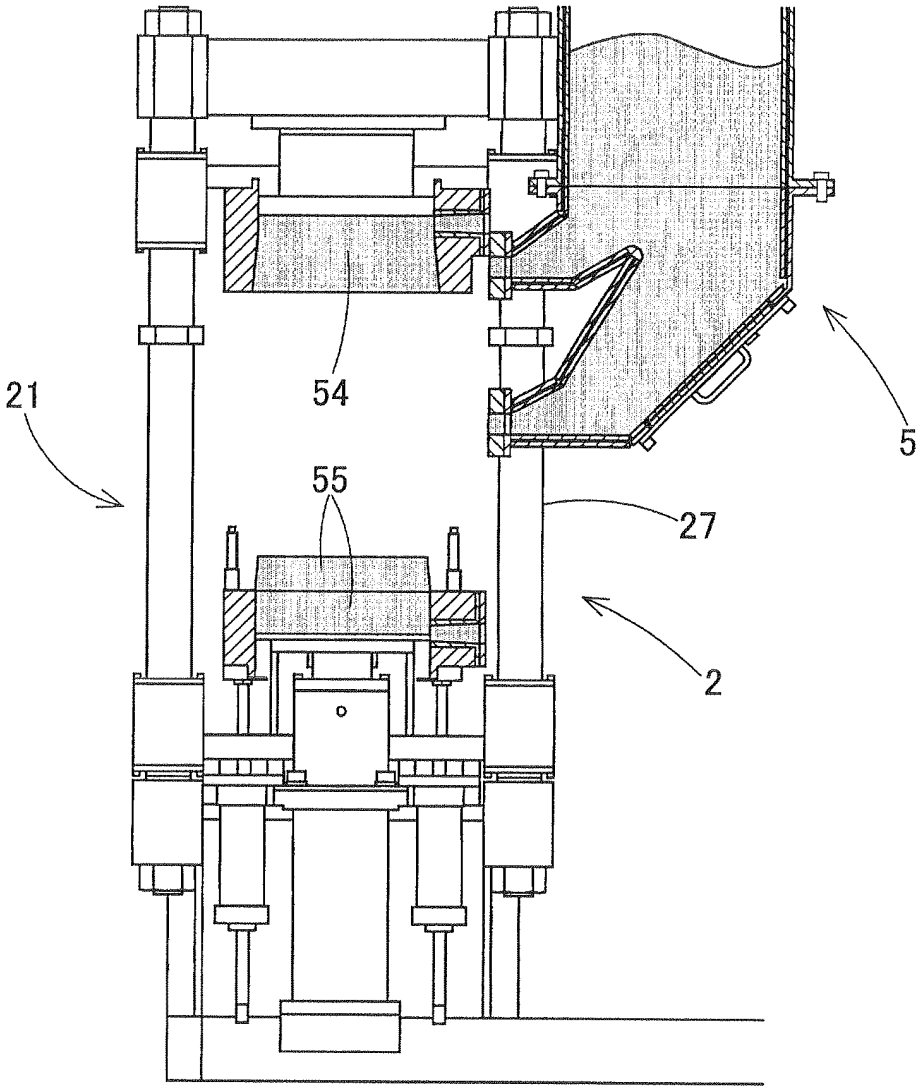


Fig.8

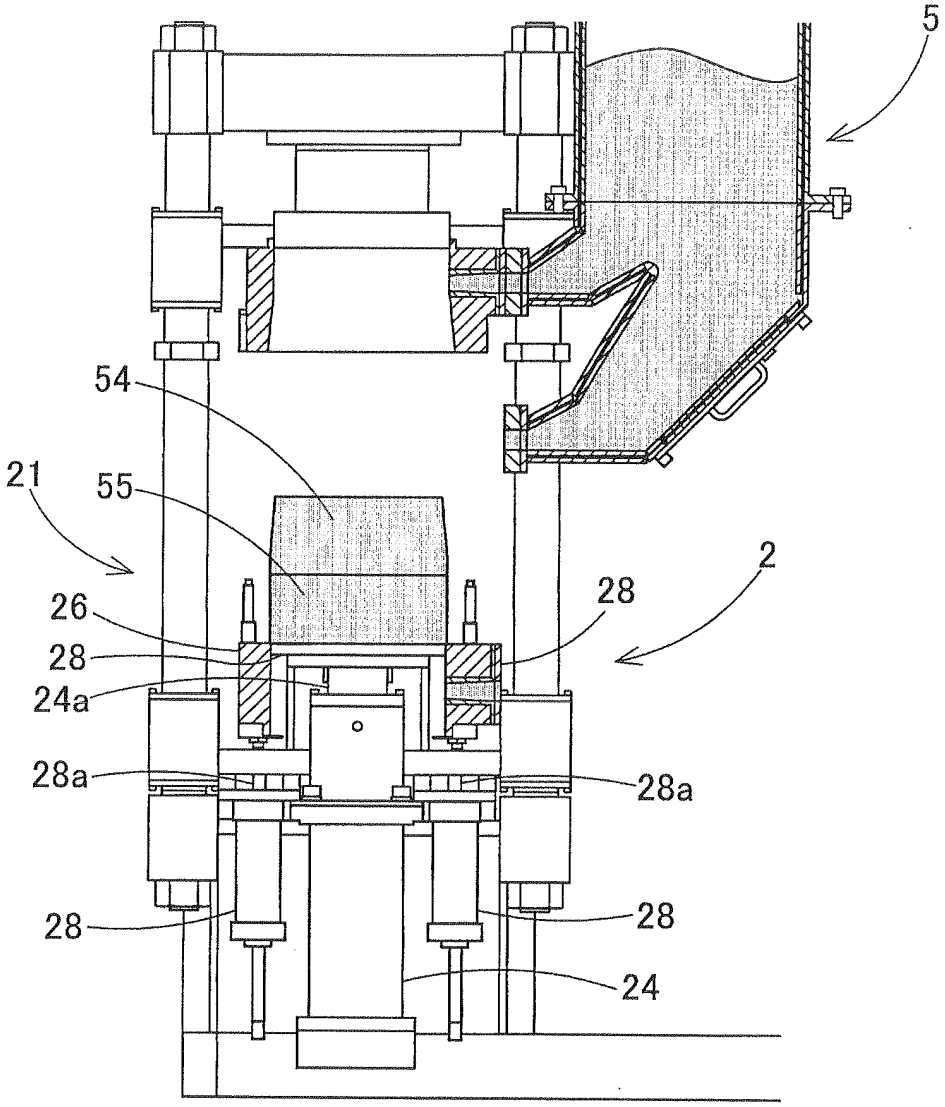


Fig.9

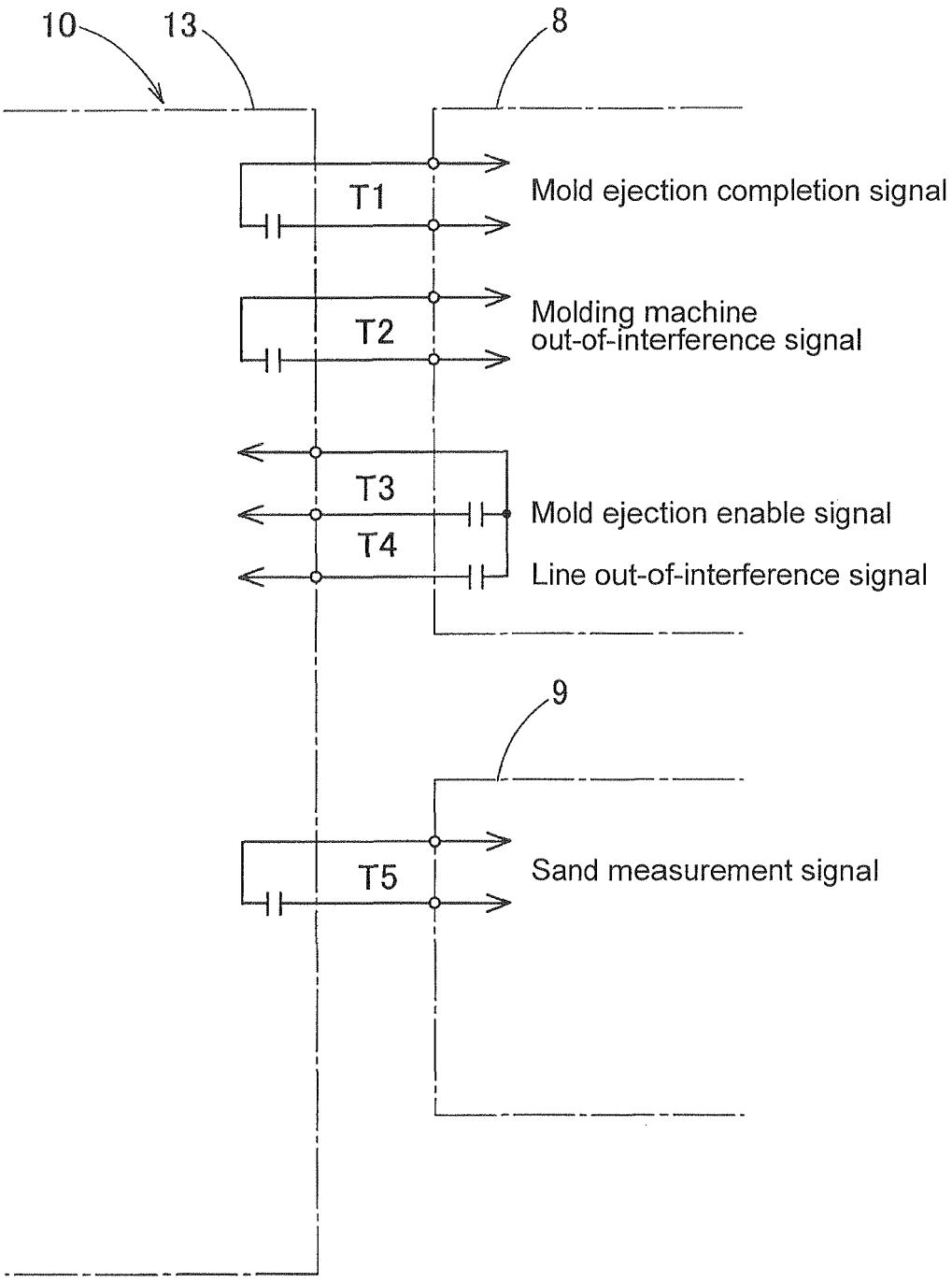

10
13
8
T1
Mold ejection completion signal
T2
Molding machine
out-of-interference signal
T3
Mold ejection enable signal
T4
Line out-of-interference signal
9
T5
Sand measurement signal

Fig.10

(a)


1
X1
M8b
K1
introduction
screen display

(b)

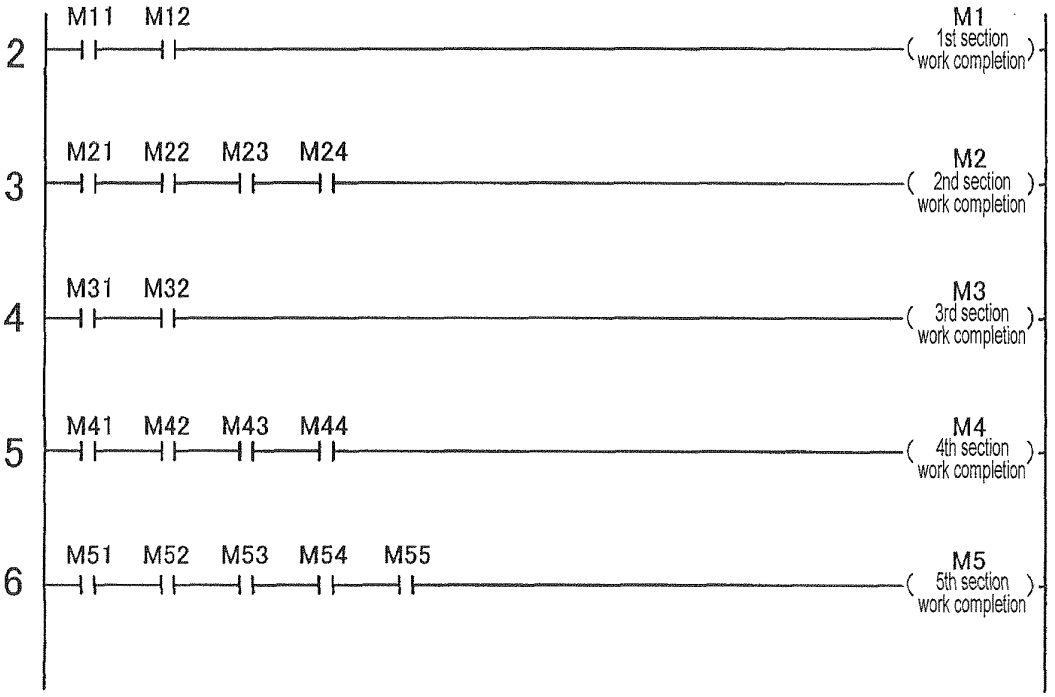

2
M11
M12
M1
1st section
work completion
3
M21
M22
M23
M24
M2
2nd section
work completion
4
M31
M32
M3
3rd section
work completion
5
M41
M42
M43
M44
M4
4th section
work completion
6
M51
M52
M53
M54
M55
M5
5th section
work completion

Fig.11

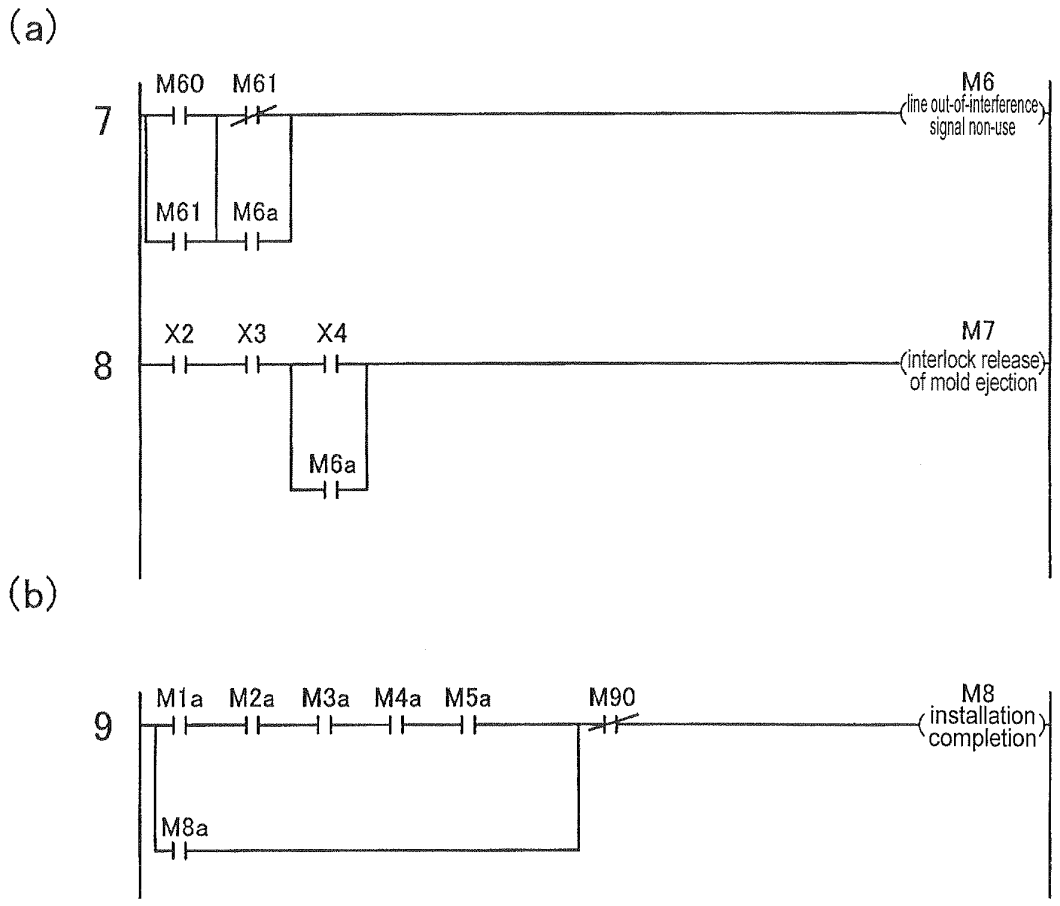

(a)
7
M60
M61
M6
line out-of-interference signal non-use
M61
M6a
8
X2
X3
X4
M7
interlock release of mold ejection
M6a
(b)
9
M1a
M2a
M3a
M4a
M5a
M90
M8
installation completion
M8a

Fig.12

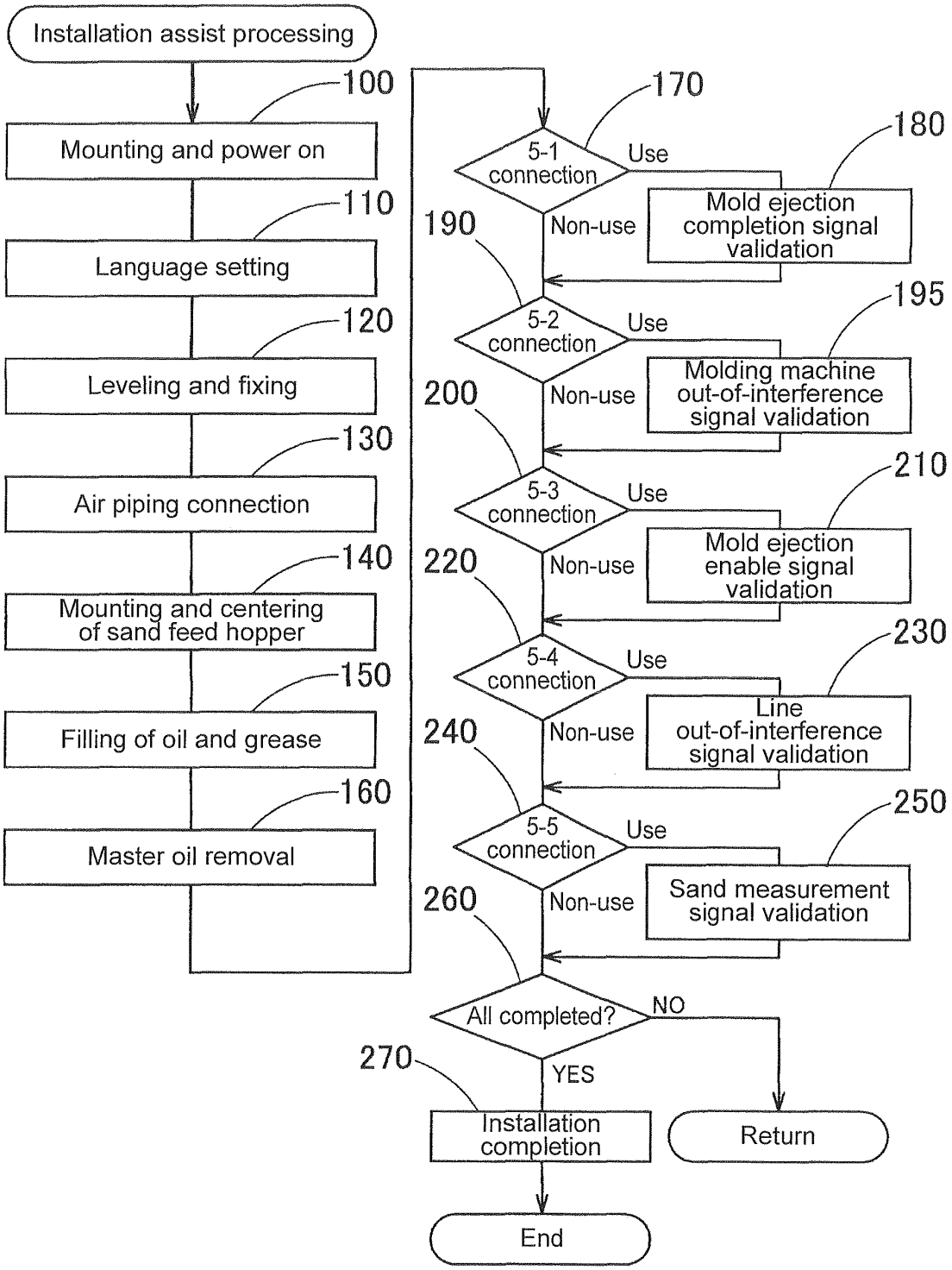
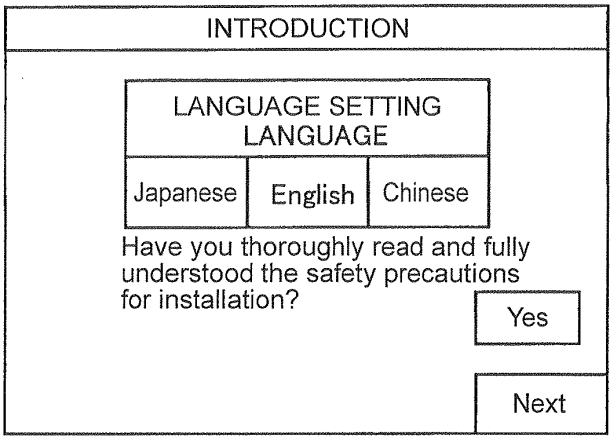
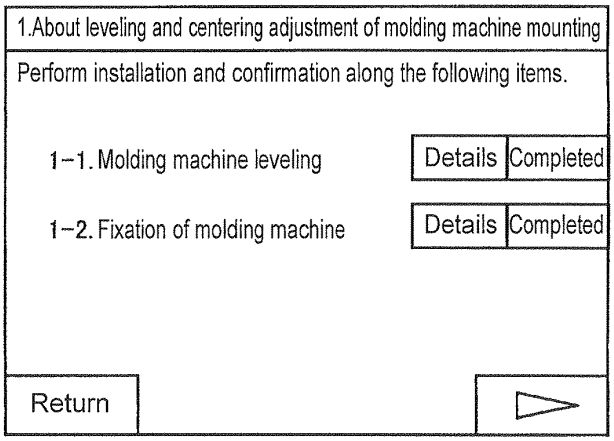

Installation assist processing
100
Mounting and power on
110
Language setting
120
Leveling and fixing
130
Air piping connection
140
Mounting and centering of sand feed hopper
150
Filling of oil and grease
160
Master oil removal
170
5-1 connection
Use
180
Mold ejection completion signal validation
Non-use
190
5-2 connection
Use
195
Molding machine out-of-interference signal validation
Non-use
200
5-3 connection
Use
210
Mold ejection enable signal validation
Non-use
220
5-4 connection
Use
230
Line out-of-interference signal validation
Non-use
240
5-5 connection
Use
250
Sand measurement signal validation
Non-use
260
All completed?
NO
YES
270
Installation completion
Return
End

Fig.13

(a)


INTRODUCTION
LANGUAGE SETTING
LANGUAGE
Japanese
English
Chinese
Have you thoroughly read and fully understood the safety precautions for installation?
Yes
Next

(b)


1.About leveling and centering adjustment of molding machine mounting
Perform installation and confirmation along the following items.
1-1. Molding machine leveling
Details
Completed
1-2. Fixation of molding machine
Details
Completed
Return

(c)

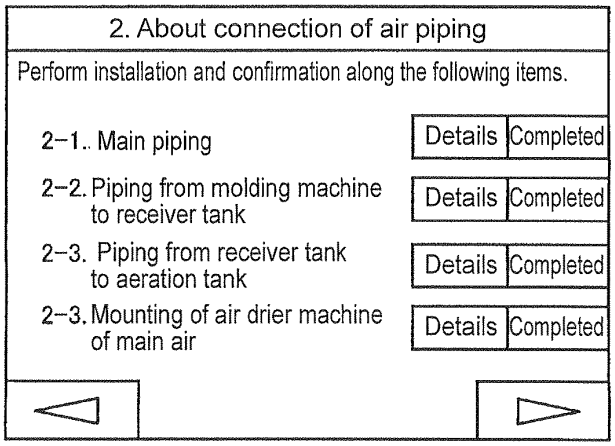
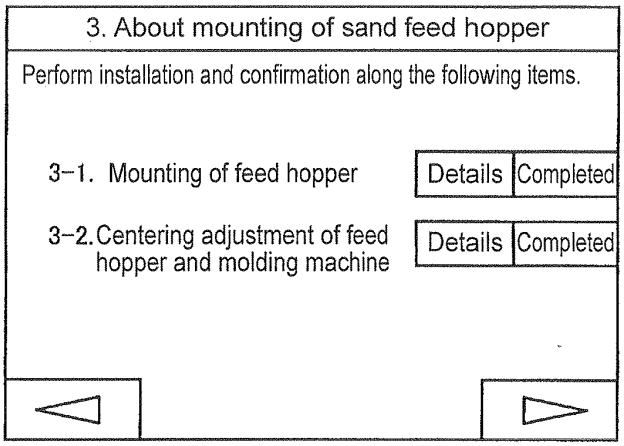

2. About connection of air piping
Perform installation and confirmation along the following items.
2-1.. Main piping
Details
Completed
2-2. Piping from molding machine to receiver tank
Details
Completed
2-3. Piping from receiver tank to aeration tank
Details
Completed
2-3. Mounting of air drier machine of main air
Details
Completed

Fig.14

(a)


3. About mounting of sand feed hopper
Perform installation and confirmation along the following items.
3-1. Mounting of feed hopper
Details
Completed
3-2. Centering adjustment of feed hopper and molding machine
Details
Completed

(b)

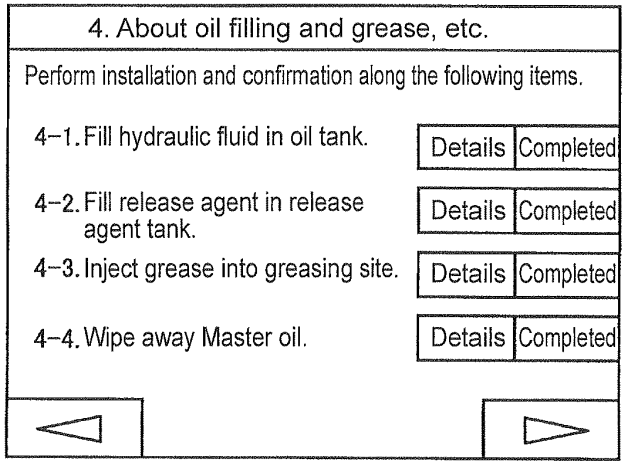
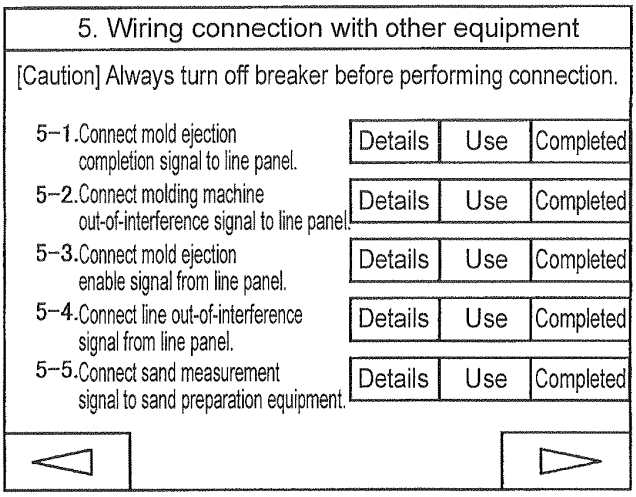
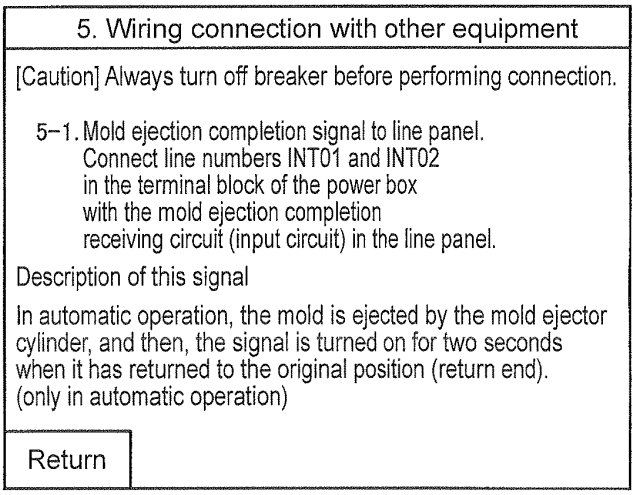

4. About oil filling and grease, etc.
Perform installation and confirmation along the following items.
4-1. Fill hydraulic fluid in oil tank.
Details
Completed
4-2. Fill release agent in release agent tank.
Details
Completed
4-3. Inject grease into greasing site.
Details
Completed
4-4. Wipe away Master oil.
Details
Completed

Fig.15

(a)


5. Wiring connection with other equipment
[Caution] Always turn off breaker before performing connection.
5-1.Connect mold ejection completion signal to line panel.
Details
Use
Completed
5-2.Connect molding machine out-of-interference signal to line panel.
Details
Use
Completed
5-3.Connect mold ejection enable signal from line panel.
Details
Use
Completed
5-4.Connect line out-of-interference signal from line panel.
Details
Use
Completed
5-5.Connect sand measurement signal to sand preparation equipment.
Details
Use
Completed

(b)


5. Wiring connection with other equipment
[Caution] Always turn off breaker before performing connection.
5-1. Mold ejection completion signal to line panel.
Connect line numbers INT01 and INT02
in the terminal block of the power box
with the mold ejection completion
receiving circuit (input circuit) in the line panel.
Description of this signal
In automatic operation, the mold is ejected by the mold ejector cylinder, and then, the signal is turned on for two seconds when it has returned to the original position (return end).
(only in automatic operation)
Return

(c)

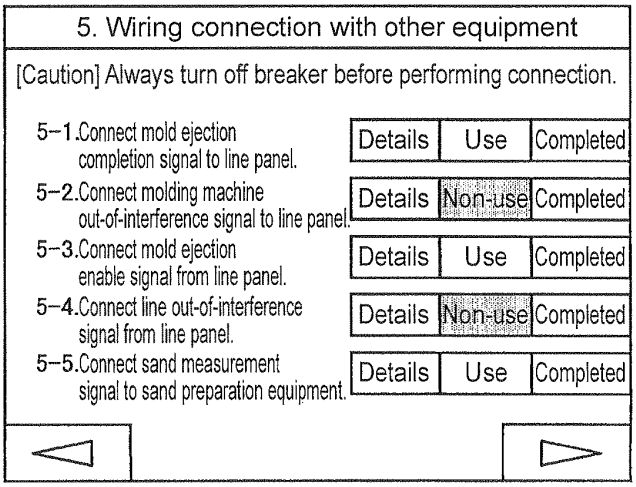
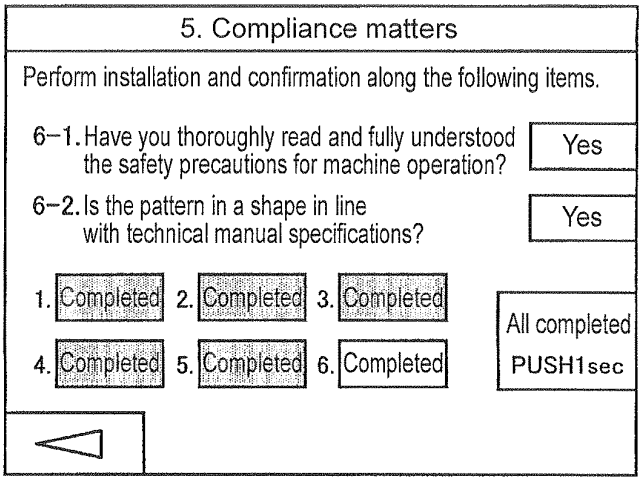
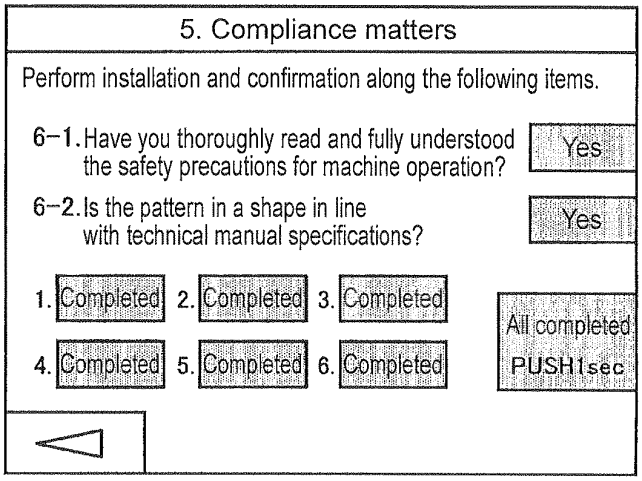

5. Wiring connection with other equipment
[Caution] Always turn off breaker before performing connection.
5-1.Connect mold ejection completion signal to line panel.
Details
Use
Completed
5-2.Connect molding machine out-of-interference signal to line panel.
Details
Non-use
Completed
5-3.Connect mold ejection enable signal from line panel.
Details
Use
Completed
5-4.Connect line out-of-interference signal from line panel.
Details
Non-use
Completed
5-5.Connect sand measurement signal to sand preparation equipment.
Details
Use
Completed

Fig.16

(a)


5. Compliance matters
Perform installation and confirmation along the following items.
6-1. Have you thoroughly read and fully understood the safety precautions for machine operation?
Yes
6-2. Is the pattern in a shape in line with technical manual specifications?
Yes
1. Completed
2. Completed
3. Completed
4. Completed
5. Completed
6. Completed
All completed
PUSH1sec

(b)


5. Compliance matters
Perform installation and confirmation along the following items.
6-1. Have you thoroughly read and fully understood the safety precautions for machine operation?
Yes
6-2. Is the pattern in a shape in line with technical manual specifications?
Yes
1. Completed
2. Completed
3. Completed
4. Completed
5. Completed
6. Completed
All completed
PUSH1sec

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/071526

A. CLASSIFICATION OF SUBJECT MATTER
B22C11/00(2006.01)i, *B22C15/02*(2006.01)i, *B22C15/24*(2006.01)i, *B22C25/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B22C11/00, B22C15/02, B22C15/24, B22C25/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 59-024552 A (Sinto Kogyo Ltd.), 08 February 1984 (08.02.1984), claims; fig. 1 (Family: none)	1-5,12 6-11
Y A	JP 2009-003788 A (Sanyo Electric Co., Ltd.), 08 January 2009 (08.01.2009), paragraphs [0001] to [0005] (Family: none)	1-5,12 6-11
Y A	JP 01-124046 A (Hitachi, Ltd.), 16 May 1989 (16.05.1989), claims (Family: none)	1-5,12 6-11

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 November, 2011 (18.11.11)	29 November, 2011 (29.11.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/071526

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2001-088069 A (Denso Corp., Harmo Co., Ltd.), 03 April 2001 (03.04.2001), claims; paragraph [0003] (Family: none)	2,3 1,4-12
Y A	WO 2008/059710 A1 (Matsushita Electric Industrial Co., Ltd.), 22 May 2008 (22.05.2008), paragraph [0071]; fig. 17 & JP 4130846 B & US 2010/0229120 A1	4 1-3,5-12
A	JP 05-073103 A (Hitachi, Ltd.), 26 March 1993 (26.03.1993), entire text (Family: none)	1-12

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H0716705 B **[0003]**