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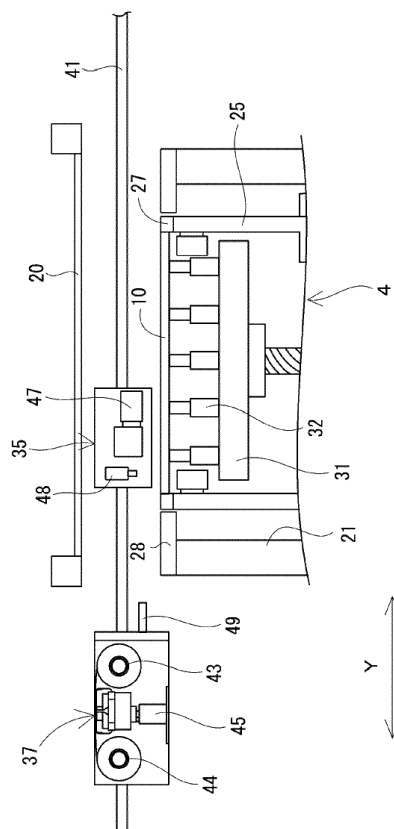
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(54) **SCREEN PRINTING MACHINE**

(57) A screen printing machine includes a mask holding device configured to hold a mask; a squeegee device configured to apply and spread cream solder from above to the mask held by the mask holding device; a conveyance device configured to convey a board below the mask; a board holding-lifting-lowering device configured to hold the board conveyed by the conveyance device and perform positioning in an upward-downward direction with respect to the mask; a cleaning device configured to wipe and clean a lower surface of the mask; an imaging device configured to image a reference mark of the mask and a reference mark of the board; a driving device configured to move the imaging device and the cleaning device between the mask and the board holding-lifting-lowering device; and a control device configured to control each of the devices, set a lifting and lowering section of the board holding-lifting-lowering device to a reference height in accordance with a size of the imaging device, and lower the lifting and lowering section from the reference height in accordance with a size of the cleaning device when the cleaning device is moved.

Fig. 3



Description

Technical Field

[0001] The present invention relates to a screen printing machine in which a height of a board at a normal time is made higher than a position thereof at a time of cleaning a mask.

Background Art

[0002] The screen printing machine is provided with a mask having a pattern hole formed thereon, and holds a board conveyed below the mask. Then, the board is lifted and comes into contact with a lower surface of the mask, and a cream solder is applied and spread by a squeegee device from an opposite upper surface side of the mask, and thereby the cream solder passing through the pattern hole is printed on the board. In such a screen printing machine, as illustrated in Patent Literature 1, a camera unit (imaging device) enters between a mask and a board positioned below the mask, and a reference mark attached to a lower surface of the mask and a reference mark attached to an upper surface of the board are sequentially imaged. Then, a position of each of the reference marks is checked by an image process and in a case where a deviation occurs, correction is performed.

[0003] Further, the screen printing machine is provided with a cleaning unit (cleaning device) for wiping the mask. The cleaning unit, like the camera unit, has a configuration capable of moving between the mask and the board. In particular, a coupling mechanism is provided in this conventional art and it is possible to attach and detach the cleaning unit and the camera unit. A driving device provided on a camera unit side is moving the two units, at a normal time, the cleaning unit is separated from the camera unit so that only the camera unit can be moved, and at a time of cleaning the mask, the cleaning unit can be moved by being coupled to the camera unit.

Patent Literature

[0004] Patent Literature 1: JP-A-2015-80870

Summary of the Invention

Technical Problem

[0005] Incidentally, the cleaning unit provided in the screen printing machine structurally has a higher height dimension than that of the camera unit, because of having roll-shaped cleaning paper, a cylinder for pressing the cleaning paper against the lower surface of the mask, or the like. Therefore, in order to secure a space for the cleaning unit to enter, it is necessary to increase an interval between the mask and the board, and the conventional screen printing machine has a long lifting and lowering distance for moving the board to the mask at a time

of printing. Therefore, in the conventional screen printing machine, there is a problem that a cycle time becomes long in accordance with the lifting and lowering distance of the board. Further, as the moving distance of the board is long, a slight error in a moving direction increases a deviation amount between the board and the mask, and there is also a problem that the printing accuracy is decreased.

[0006] In order to solve such a problem, an object of the present invention is to provide a screen printing machine in which a position of a board corresponds to a height dimension of an imaging device.

Solution to Problem

[0007] A screen printing machine in an aspect of the present invention includes a mask holding device configured to hold a mask; a squeegee device configured to apply and spread cream solder from above to the mask held by the mask holding device; a conveyance device configured to convey a board below the mask; a board holding-lifting-lowering device configured to hold the board conveyed by the conveyance device and perform positioning in an upward-downward direction with respect to the mask; a cleaning device configured to wipe and clean a lower surface of the mask; an imaging device configured to image a reference mark of the mask and a reference mark of the board; a driving device configured to move the imaging device and the cleaning device between the mask and the board holding-lifting-lowering device; and a control device configured to control each of the devices, set a lifting and lowering section of the board holding-lifting-lowering device to a reference height in accordance with a size of the imaging device, and lower the lifting and lowering section from the reference height in accordance with a size of the cleaning device when the cleaning device is moved.

Advantageous Effect of the Invention

[0008] According to the configuration, after the board is conveyed by the conveyance device below the mask held by the mask holding device, the board is held by the board holding-lifting-lowering device and positioned so as to come into contact with the lower surface of the mask. Then, the cream solder is applied and spread by the squeegee device from above the mask, and printing is performed on the board. Further, at a time of such board printing, the imaging device enters between the mask and the board by the driving device, imaging of the reference mark is performed, and after the printing process is performed a predetermined number of times, the cleaning device enters and performs wiping and cleaning of the lower surface of the mask. Then, in the board holding-lifting-lowering device, at a normal time during which the printing is performed, since the lifting and lowering section is set to the reference height corresponding to the size of the imaging device, the held board is disposed at

a distance close to the mask, and at a time of cleaning the mask, the lifting and lowering section is prevented from interfering with the cleaning device by being lowered.

Brief Description of Drawings

[0009]

Fig. 1 is a side view illustrating a simplified internal structure of a screen printing machine.

Fig. 2 is a view illustrating a simplified structure of a board holding-lifting-lowering device of the screen printing machine.

Fig. 3 is a view illustrating a simplified moving periphery of a camera unit and a cleaning unit.

Fig. 4 is a view illustrating a height of a board at a normal time.

Fig. 5 is a view illustrating the height of the board at a time of cleaning when the cleaning unit moves.

Fig. 6 is a view conceptually illustrating a positional relationship between the board, the mask, and the camera unit.

Description of Embodiments

[0010] Next, an embodiment of a screen printing machine according to the present invention will be described below with reference to the drawings. Fig. 1 is a side view illustrating a simplified internal structure of the screen printing machine. Screen printing machine 1 is intended to print cream solder with respect to a board and constitutes, for example, a circuit board production line together with an inspector that inspects a printing state, a component mounter that mounts electronic components on the board, and the like. In the present embodiment, a forward-rearward direction of a machine body of screen printing machine 1 to be illustrated will be described as a Y-axis direction, a width direction of the machine body as an X-axis direction, and a height direction of the machine body as a Z-axis direction.

[0011] In screen printing machine 1, a mask is disposed inside the machine body, the board is conveyed and held below the mask, and cream solder is applied from an upper surface of the mask to the board on the lower side through a printing pattern hole. Therefore, screen printing machine 1 has a mask holder 2 on the upper side and to which the mask can be attached. On an upper side of mask holder 2, squeegee device 3, which applies and spreads the cream solder on the mask in the forward-rearward direction of the machine body, is installed. On the other hand, below mask holder 2, board holding-lifting-lowering device 4 is provided which holds the conveyed board to move the conveyed board in the upward-downward direction.

[0012] Although screen printing machine 1 is covered by machine body cover 19 as illustrated, and conveying ports 191 are formed on both side portions in the width

direction of the machine body, so that convey-in and convey-out of the board is performed. Therefore, below mask holder 2, a board conveyance device, which conveys the board in the width direction of the machine body, is provided. Further, below mask holder 2, a clamping device for clamping the board in the forward-rearward direction of the machine body, a backup device for lifting and lowering the board to a clamping position, and the like are assembled to the lifting and lowering device. In the present embodiment, the clamping device, the lifting and lowering device, and the like are collectively referred to as board holding-lifting-lowering device 4. Fig. 2 is a view illustrating a simplified structure of board holding-lifting-lowering device 4 of screen printing machine 1 described above.

[0013] First, lifting and lowering device 8 is configured so that lifting and lowering table 12 is slidably attached to guide rail 11 in the vertical direction, and lifting and lowering table 12 is coupled to lifting and lowering motor 14 via ball screw 13. On an upper portion of lifting and lowering table 12, board conveyance device 5, clamping device 6, and the like are mounted via support table 15. Support table 15 is provided with a pair of mask supports 21 in the forward-rearward direction (Y-axis direction) of the machine body, and mask supporting plate 28 coming into contact with mask 20 is fixed to an upper surface of each of leg bodies. Mask support 21 on a right side of the drawing is constituted of ball screw 22 and a distance from mask support 21 on a left side of the drawing can be adjusted by a mask support motor.

[0014] In clamping device 6, a pair of side frames 25 in the forward-rearward direction of the machine body are disposed and are respectively assembled to support table 23. Side frame 25 on the right side of the drawing is constituted of ball screw 26 and a distance from side frame 25 on the left side of the drawing can be adjusted by the board clamping motor. The pair of side frames 25 are formed of clamp sections 27 at upper end portions thereof, clamp sections 27 approach to each other, and thereby board 10 can be held by being sandwiched. Then, on an inside of side frame 25, board conveyance device 5 constituted of conveyor belts 29 is assembled.

[0015] Backup device 7, which supports board 10, is provided between the pair of side frames 25. Backup device 7 is configured so that backup table 31 including multiple backup pins 32 is supported via a ball screw, and is lifted and lowered by backup motor 34. Further, support table 23 of clamping device 6 is configured to be supported via a ball screw, and lifted and lowered by lifting and lowering motor 33. Then, support table 15 for supporting clamping device 6 and backup device 7 has a configuration capable of position adjustment in an X-direction, a Y-direction, and a θ -direction on an X-Y plane with respect to lifting and lowering table 12. That is, a correction device is configured to adjust positions of held board 10 and mask 20.

[0016] Screen printing machine 1 is configured of board holding-lifting-lowering device 4 where clamping

device 6, backup device 7, and the like are assembled to lifting and lowering device 8 below mask 20, and is configured to change a height of board 10 stepwise. In particular, in the present embodiment, a position of lifting and lowering table 12 illustrated in Fig. 2 is configured as reference height K, and reference height K is intended to specify a conveyance height of board 10 to be conveyed by board conveyance device 5. That is, in a state where lifting and lowering table 12 is positioned at the reference height, and clamping device 6 and backup device 7 are lowered as illustrated in Fig. 2, board conveyance device 5 assembled to clamping device 6 is at a conveyance position.

[0017] Conveyor belt 29 constituting board conveyance device 5 is assembled to clamping device 6 at a position lower than clamp section 27. Therefore, conveyed board 10 is configured to move upward by backup device 7 in order to align an upper surface thereof to clamp section 27. After printing, it is moved downward conversely and an upper surface height of conveyor belt 29 is set in accordance with a thickness, a warpage amount, or the like of board 10, which is capable of being processed by screen printing machine 1, in a way such that a moving distance in the upward-downward direction is reduced.

[0018] Further, clamping device 6 is configured to move held board 10 upward such that the upper surface thereof is aligned with mask supporting plate 28. After printing, it is moved downward conversely and also in this case, clamping device 6 is configured such that the upper surface height of clamp section 27 with respect to mask supporting plate 28 is set to reduce the moving distance in the upward-downward direction. Therefore, in board holding-lifting-lowering device 4, a relationship between heights of respective members is set, the height of the upper surface of conveyor belt 29 with respect to the upper surface of mask supporting plate 28 also becomes a height set in advance.

[0019] Next, as illustrated in Fig. 3, camera unit 35 (imaging device) for imaging the reference marks marked to board 10 and mask 20, cleaning unit 37 (cleaning device) for cleaning mask 20 by wiping off from a lower surface side are provided between mask holder 2 and board holding-lifting-lowering device 4. Fig. 3 is a simplified view illustrating a moving area of camera unit 35 and cleaning unit 37. In particular, a state is illustrated in which camera unit 35 and cleaning unit 37 are separated, and only camera unit 35 is illustrated as entering between board 10 and mask 20. Incidentally, in screen printing machine 1 illustrated in Fig. 1, arrow A1 is a movement range of camera unit 35 and cleaning unit 37, and arrow A2 is a movement range of board 10.

[0020] Camera unit 35 and cleaning unit 37 are configured to be slidably attached to guide rod 41 extending in the forward-rearward direction of the machine body, and movable by a driving device. The driving device of the present embodiment, similar to the conventional art, is configured so that only camera unit 35 can freely run.

In the driving device, for example, a screw shaft which is rotated by a drive motor is provided in parallel with guide rail 41, and a nut fixed to camera unit 35 side therein is screwed to configure the ball screw. Then, in order to allow movement of cleaning unit 37 by connection with camera unit 35, which can freely run, couplers are configured in the both units.

[0021] First, cleaning unit 37 is configured so that a roll-shaped cleaning paper is used and is unwound from first roller 43 before use, and a used portion, by which mask 20 has been wiped off, is wound by second roller 44. Wind-up (unwinding from first roller 43) of cleaning paper by a servomotor provided on second roller 44 side is performed, and for pressing the cleaning paper against a lower surface of mask 20, a paper pressing mechanism using air cylinder 45 is incorporated between both rollers. On the other hand, a prism is combined to camera 47 to image both the upper mask and the lower board by camera unit 35.

[0022] Then, solenoid 48 for vertically extending and retracting a plunger is provided inside camera unit 35, a through-hole is formed in cleaning unit 37, and coupling plate 49 protrudes to camera unit 35 side. Such solenoid 48 and coupling plate 49 are a coupler for coupling between camera unit 35 and cleaning unit 37. Therefore, the plunger of solenoid 48 extends downward and is inserted into the through-hole of coupling plate 49 inserted into camera unit 35, and thereby cleaning unit 37 is coupled to camera unit 35 and can integrally move.

[0023] As illustrated in Fig. 1, a standby position of cleaning unit 37 is a front portion of screen printing machine 1. Therefore, in a case where the cleaning of mask 20 is performed by using cleaning unit 37, camera unit 35 moves to the standby position, so that the connection thereof to cleaning unit 37 is performed. On the other hand, in a state where the plunger of solenoid 48 is pulled up, camera unit 35 and cleaning unit 37 are separated, and imaging of the reference marks marked to board 10 and mask 20 is performed by moving only camera unit 35.

[0024] Incidentally, camera unit 35 and cleaning unit 37 are entirely covered by the unit cover and a dimension of cleaning unit 37 in a height direction is larger than a height dimension of camera unit 35. This is because the roll-shaped cleaning paper wound around first and second rollers 43 and 44, and air cylinder 45 and the like for pressing the cleaning paper against the mask are incorporated therein. In this regard, in the conventional screen printing machine, an interval between board 10 and mask 20 is designed to correspond to the height dimension of cleaning unit 37 having a large size. Therefore, a moving distance of board 10 becomes long, a cycle time is long, and the positional accuracy of board 10 with respect to mask 20 is decreased.

[0025] Therefore, screen printing machine 1 is configured so that the height of board 10 is switched between the normal time illustrated in Fig. 4 and the cleaning time illustrated in Fig. 5. Cleaning unit 37 at the normal time is disposed at the standby position illustrated in Fig. 1,

so that only camera unit 35 enters between board 10 and mask 20. In the present embodiment, the upper surface of mask supporting plate 28 illustrated in Fig. 4 is set as reference height k2 and a conveyance height of board 10 to be conveyed into screen printing machine 1 is set. In board holding-lifting-lowering device 4, where board conveyance device 5 and the like are mounted on lifting and lowering device 8, there is a possibility that the lifting and lowering section displaced in the upward-downward direction interferes with camera unit 35 and cleaning unit 37 entering below mask 20. Therefore, in the present embodiment, the upper surface of supporting plate 28 closest to mask 20 is reference height k2 in the lifting and lowering section. Incidentally, as illustrated in Fig. 2, reference height k2 is the upper surface height of mask supporting plate 28 in a case where lifting and lowering table 12 is positioned at reference height K.

[0026] Here, Fig. 6 is a view conceptually illustrating a positional relationship between board 10 positioned at reference height k2, mask 20 held by mask holder 2, and camera unit 35. For example, distance L2 between camera unit 35 and mask 20 is set to 3mm. Therefore, reference height k2 is designed so that distance L1 from camera unit 35 to board 10 is 5mm, that is, there is almost no difference between distances L1 and L2 and they are substantially the same extent. Originally by setting distances L1 and L2 to the same value, it is possible to minimize distance L3 between board 10 and mask 20, but the value of distance L1 is slightly larger than that of distance L2 in a same extent considering an amount of a state change such as a warpage that may occur in board 10.

[0027] On the other hand, at the time of cleaning mask 20, as illustrated in Fig. 5, since cleaning unit 37 moves below mask 20, not only camera unit 35 but also cleaning unit 37 moves between board 10 and mask 20. Then, since cleaning unit 37 is aligned with camera unit 35 on the upper surface and is larger on the lower side than that of camera unit 35, it is configured to be lowered by predetermined retraction distance L4 from reference height k2 so that board 10 does not interfere therewith. Since board 10 is not necessarily held at the time of cleaning mask 20, a space between board 10 and mask 20 means a space between the height of board 10 and mask 20 in a case where board 10 is held.

[0028] Subsequently, as illustrated in Fig. 2, control device 9 for controlling the entire drive is mounted on screen printing machine 1 and the drive control of each of the devices including the lifting and lowering control of board 10 is performed as follows. First, in printing on board 10 in screen printing machine 1, board 10 is conveyed between side frames 25 by conveyor belt 29. Then, backup table 31 is lifted by the drive of backup motor 34, board 10 pushed up by backup pin 32 is lifted from conveyor belt 29. After position alignment of board 10, side frame 25 is moved by the drive of the board clamping motor and board 10 is sandwiched by a pair of clamp sections 27 to be held.

[0029] Next, clamping device 6 holding board 10 by the drive of lifting and lowering motor 33 is lifted, and clamp section 27 and board 10 are positioned to the height of mask supporting plate 28. That is, mask supporting plate 28, clamp section 27, and the upper surface height of board 10 are aligned with reference height K. Then, camera unit 35 moves between board 10 and mask 20, imaging of each of the reference marks is performed, deviation amounts in X, Y, and θ directions for board 10 and mask 20 are calculated based on the imaging data, and a positional deviation correction is performed by a correction device configured in support table 15.

[0030] When camera unit 35 moves out of a lifting and lowering range of board 10, in board holding-lifting-lowering device 4, lifting and lowering table 12 is lifted by the drive of lifting and lowering motor 14 from the position of reference height K, and board 10 is positioned at a height where board 10 comes into contact with the lower surface of mask 20. Then, the cream solder on mask 20 is rolled by squeegee device 3, pushed into the printing pattern hole, and applied to board 10 on the lower side. Thereafter, plate release is performed to lower board 10 at a predetermined speed by drive of lifting and lowering motor 33, and printing by the cream solder according to a printing pattern is performed on board 10.

[0031] When printing is performed on board 10, lifting and lowering table 12 is lowered by the drive of lifting and lowering motor 14 to be returned to the position of reference height K. Thereafter, clamping device 6 holding board 10 is lowered by the drive of lifting and lowering motor 33, backup table 31 is lowered by the drive of backup motor 34, and board 10 placed on backup pins 32 is returned to conveyor belt 29. Thus, the positions of clamping device 6 and backup device 7 are returned to the board conveyance height illustrated in Fig. 2, and thereby board 10 can be conveyed by board conveyance device 5, board 10 after printing is conveyed out from screen printing machine 1, and new board 10 is conveyed in.

[0032] In screen printing machine 1, as described above, the printing process for board 10, and the convey-in and conveyance of board 10 are repeatedly performed, and cleaning for mask 20 is performed for each printing process to a predetermined number of boards 10. At the time of cleaning the mask, camera unit 35 moves to cleaning unit 37 at the standby position as illustrated in Fig. 1, and the coupling between the both is performed. That is, coupling plate 4 on cleaning unit 37 side is inserted into camera unit 35 and the plunger of solenoid 48 is inserted into the through-hole.

[0033] On the other hand, board holding-lifting-lowering device 4 is configured so that lifting and lowering table 12 is lowered by the drive of lifting and lowering motor 14 and retracted downward by a predetermined distance from reference height K, and thereby board 10, mask supporting plate 28, and the like do not interfere with cleaning unit 37. The retraction position thereof is lower than the conveyance height of the board. Therefore,

cleaning unit 37 can enter between board 10 and mask 20, and the cleaning paper is pressed against the lower surface of mask 20 to wipe off. After the cleaning of mask 20 is completed, cleaning unit 37 is returned to the standby position again, and the connection with camera unit 35 is separated. Then, in board holding-lifting-lowering device 4, lifting and lowering table 12 is lifted by the drive of lifting and lowering motor 14, and the upper surface of mask supporting plate 28 is returned to reference height Kk2.

[0034] Therefore, according to the present embodiment, at a normal time, since board 10 is held and positioned at a position close to mask 20, the lifting and lowering distance to mask 20 is shortened, and the time required for the lifting and lowering operation at the time of printing is shortened. For example, as compared with the conventional art in which the position of board 10 corresponds to cleaning unit 37, in the present embodiment, by corresponding to camera unit 35 having a small size, the position of board 10 approaches mask 20 by 25mm. Therefore, the moving distance of board 10 at the time of printing is as much as 50 mm in a round trip, and a cycle time can be shortened.

[0035] Further, it is possible to improve the positional accuracy of board 10 with respect to mask 20 by shortening the moving distance of board 10. Board 10 is lifted and lowered in accordance with the movement of lifting and lowering table 12 along guide rail 11, and the moving direction thereof is designed to match the vertical direction, but as illustrated in Fig.6, slight deviation (angle θ) occurs. Therefore, at the arrival position of board 10 coming into contact with mask 20, lateral deviation B occurs between board 10 and mask 20. For example, if distance L3 between board 10 and mask 20 is 125mm in the present embodiment and is 150mm in the conventional art, a difference in lateral deviation B is substantially 44μ , even if the value of the angle θ is 0.1° . Since the printing on board 10 is required to have an accuracy of several tens of micrometers, the present embodiment is also effective in improving the printing accuracy.

[0036] Incidentally, in screen printing machine 1, cleaning unit 37 is larger in size than that of camera unit 35. It is preferable that cleaning unit 37 be attached with cleaning paper having a large diameter in consideration of usage efficiency and the like. However, for cleaning mask 20, since it moves on board holding-lifting-lowering device 4, in the case of cleaning unit 37 having a large dimension in the height direction in accordance with the cleaning paper, it is necessary to secure a larger space which only does not interfere therewith.

[0037] Therefore, in the present embodiment, a disadvantage that an increase in the stroke of lifting and lowering table 12 at the time of printing is eliminated while improving the usage efficiency of cleaning unit 37. That is, the lifting and lowering stroke of lifting and lowering table 12 performed for each board 10 may be set in accordance with small camera unit 35 regardless of the size of cleaning unit 37. On the other hand, at the time of

cleaning mask 20, lifting and lowering table 12 is lowered to create a large space as in the conventional art, so that the disadvantage of cleaning unit 37 using the cleaning paper having a large diameter can be eliminated.

[0038] While an embodiment of the present invention has been described above, the present invention is not limited thereto, and various changes can be made without departing from the spirit thereof. For example, in the above embodiment, cleaning unit 37 is movable by coupling to camera unit 35 which can freely run, but cleaning unit 37 may have a self-propelled structure for converting a rotation output of the drive motor into a linear motion by a ball screw. Further, the driving device for running each of the units may have other structures for converting the rotation of the drive motor into the linear motion via pulleys and a belt.

[0039] Further, a case where cleaning unit 37 is aligned with the upper surface of camera unit 35 can make distance L2 with mask 20 smallest, but based on center positions of both units in the height direction, a structure may be provided which is assembled in a relationship that the center of camera unit 35 in the height direction is above the center of large cleaning unit 37 in the height direction.

Reference Signs List

[0040] 1... screen printing machine, 2... mask holder, 3... squeegee device, 4... board holding-lifting-lowering device, 5... board conveyance device, 6... clamping device, 7... backup device, 8... lifting and lowering device, 9... control device, 10... board, 14... lifting and lowering motor, 20... mask, 27... clamp section, 28... mask supporting plate, 35... camera unit, 37... cleaning unit

Claims

1. A screen printing machine comprising:

- a mask holding device configured to hold a mask;
- a squeegee device configured to apply and spread cream solder from above to the mask held by the mask holding device;
- a conveyance device configured to convey a board below the mask;
- a board holding-lifting-lowering device configured to hold the board conveyed by the conveyance device and perform positioning in an upward-downward direction with respect to the mask;
- a cleaning device configured to wipe and clean a lower surface of the mask;
- an imaging device configured to image a reference mark of the mask and a reference mark of the board;
- a driving device configured to move the imaging

device and the cleaning device between the mask and the board holding-lifting-lowering device; and

a control device configured to control each of the devices, set a lifting and lowering section of the board holding-lifting-lowering device to a reference height in accordance with a size of the imaging device, and lower the lifting and lowering section from the reference height in accordance with a size of the cleaning device when the cleaning device is moved.

2. The screen printing machine according to Claim 1, wherein the driving device is configured to directly move the imaging device, and move the cleaning device via a coupler provided between the cleaning device and the imaging device.
3. The screen printing machine according to Claim 1 or 2, wherein imaging of the reference mark is performed by the imaging device with respect to the board disposed at the holding height by the board holding-lifting-lowering device.
4. The screen printing machine according to any one of Claims 1 to 3, wherein a holding height of the board is set so that a distance from the imaging device for imaging the reference mark is substantially the same as a distance between the mask and the imaging device.

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Fig. 1

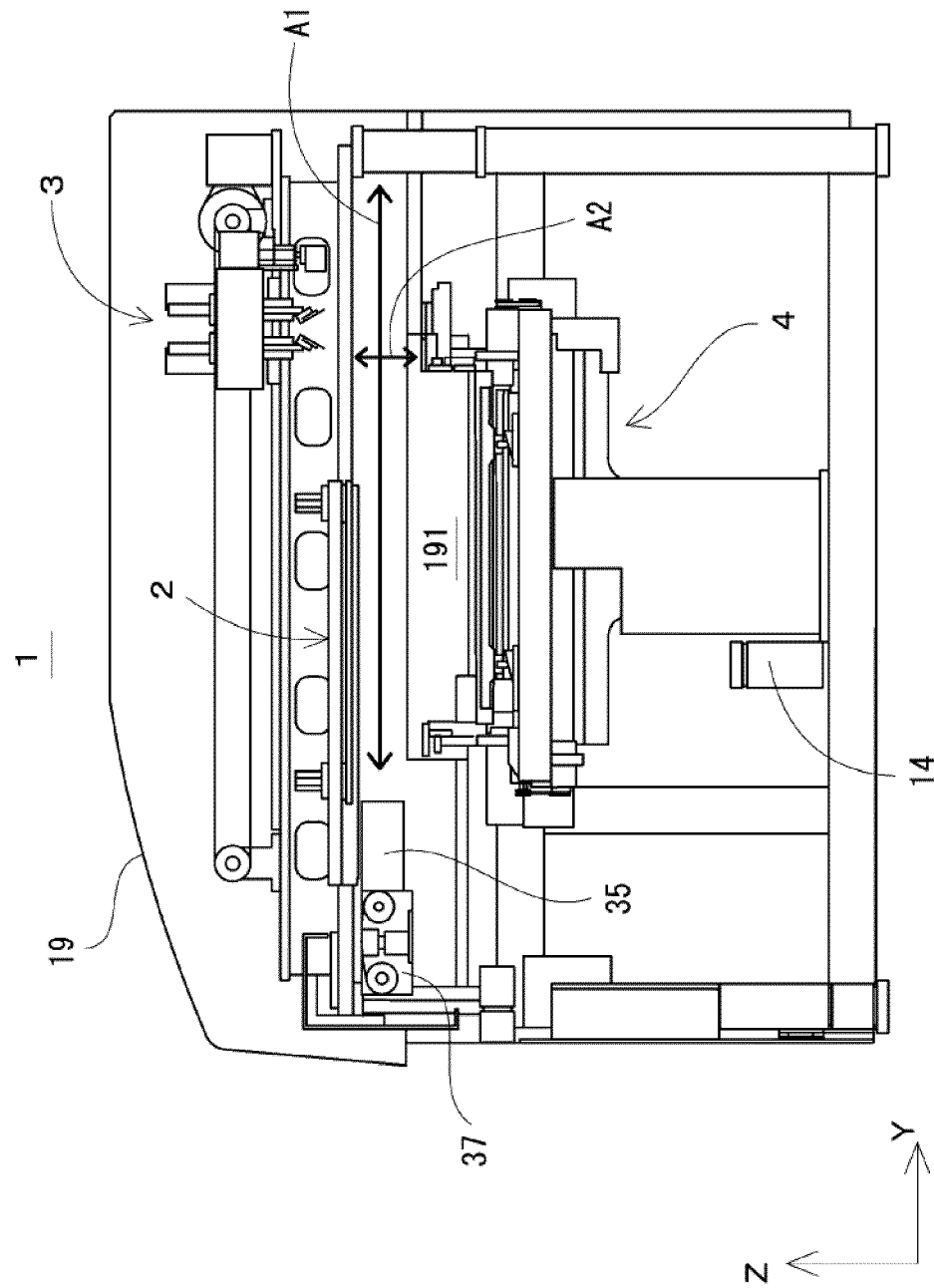


Fig. 2

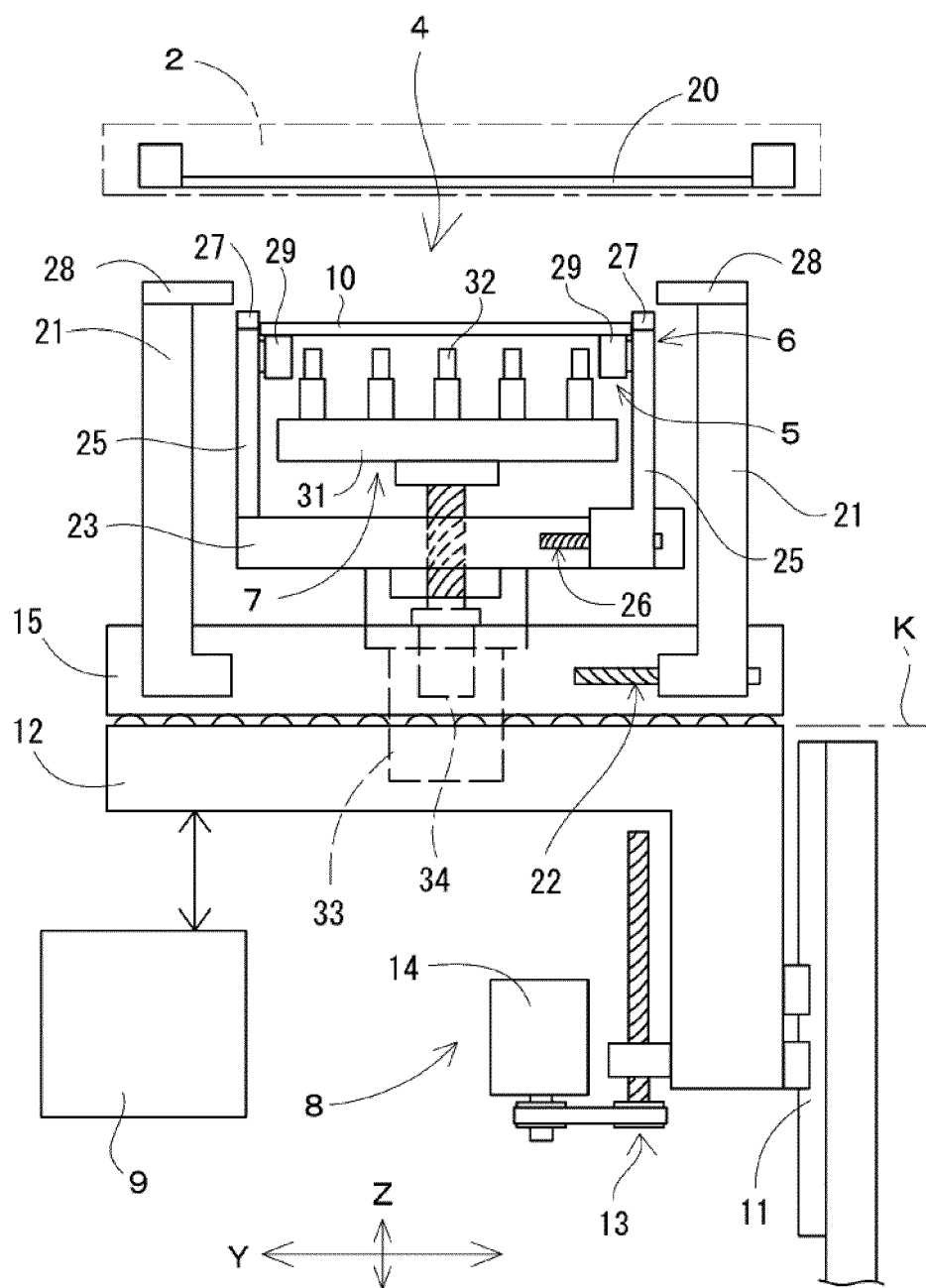


Fig. 3

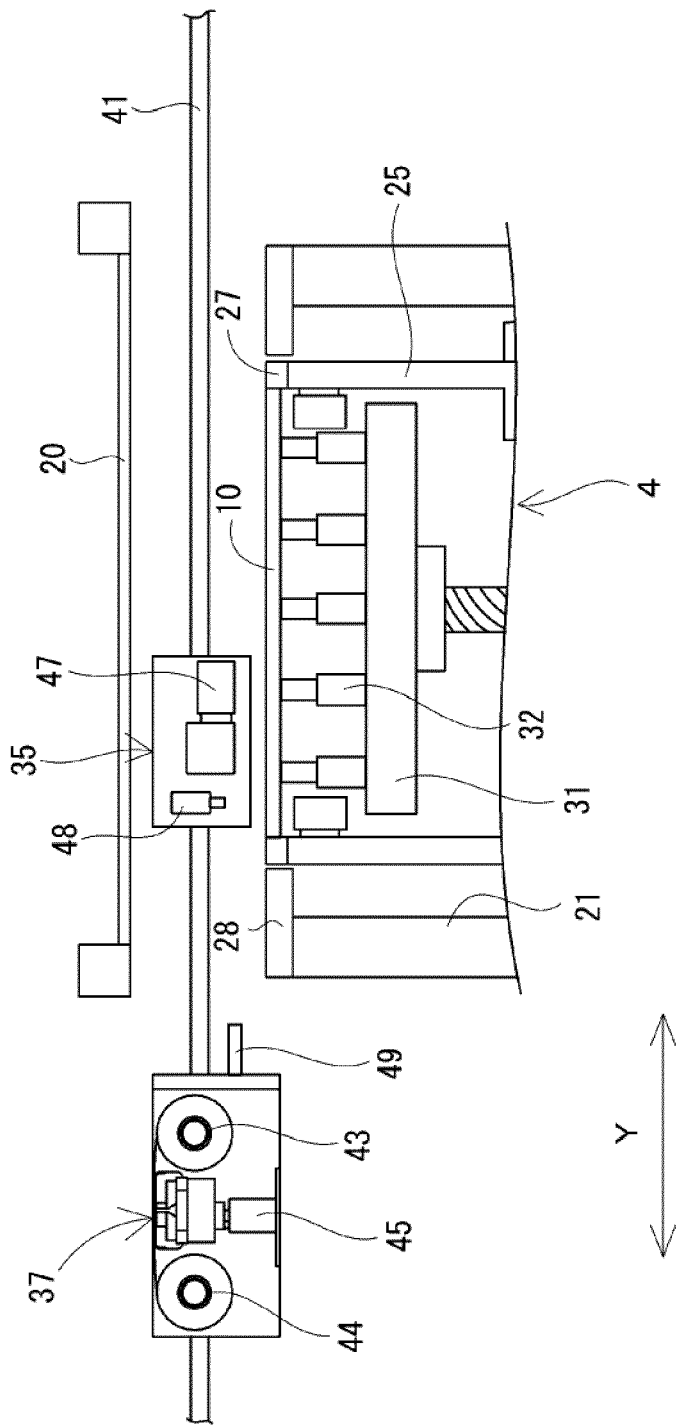


Fig. 4

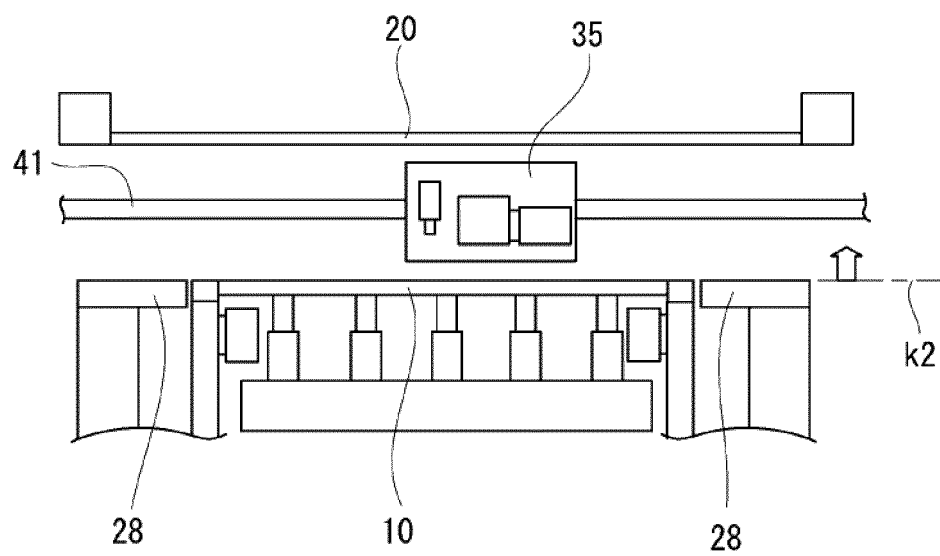


Fig. 5

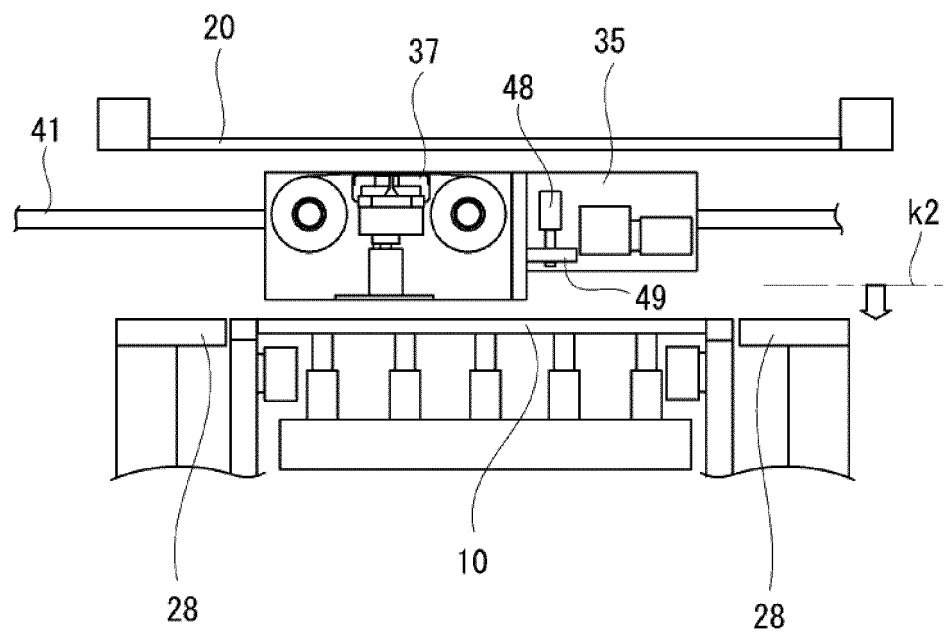
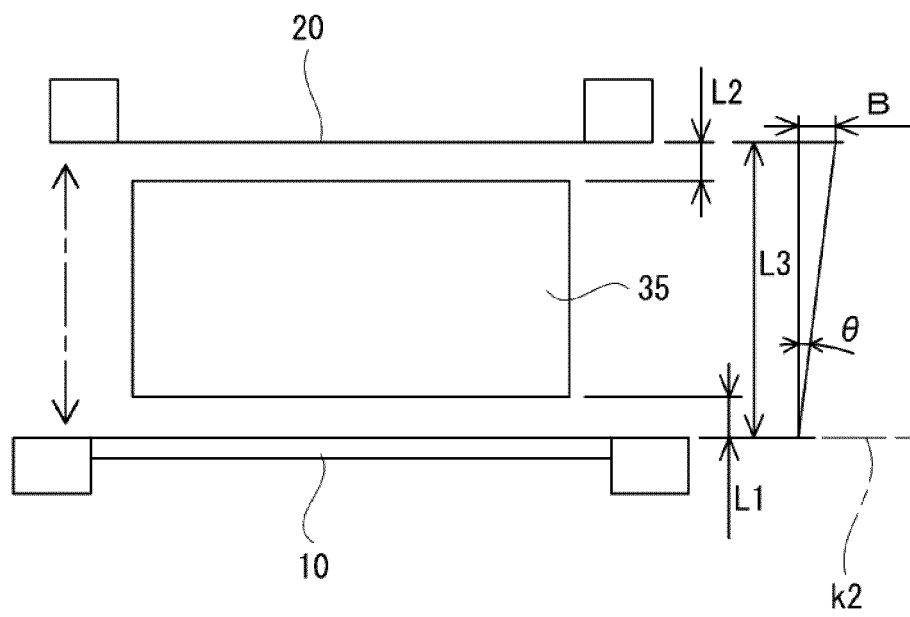


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/021355

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. B41F15/12(2006.01)i, B41F15/08(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)

Int. Cl. B41F15/00-15/46, B41F35/00-35/06, H05K3/12, H05K3/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

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.
A	JP 2006-289784 A (YAMAHA MOTOR CO., LTD.) 26 October 2006, paragraphs [0024], [0025], [0050], [0051], [0080], fig. 13, 14 & CN 1846995 A	1-4
A	JP 2005-262689 A (HITACHI IND CO., LTD.) 29 September 2005, paragraphs [0010]-[0013], [0016] (Family: none)	1-4
A	JP 2015-80870 A (FUJI MACHINE MFG. CO., LTD.) 27 April 2015, entire text, all drawings & CN 104553268 A	1-4
A	JP 3085316 U (TENRYUSEIKI CO., LTD.) 06 February 2002, entire text, all drawings (Family: none)	1-4



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5775220 A (THATCHER, Robert M.) 07 July 1998, entire text, all drawings (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015080870 A [0004]