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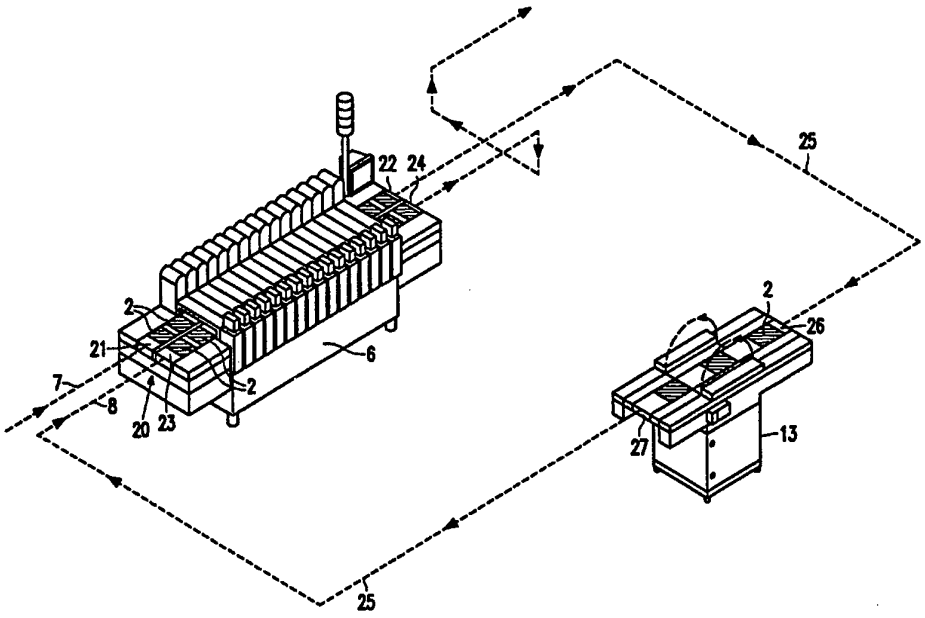
(54) Title: METHOD OF PROCESSING PRINTED CIRCUIT BOARDS AND DEVICE THEREFORE




(57) Abstract

The invention relates to a method of processing printed circuit boards which are transported consecutively through a number of processing stations, among which a component placement machine (6), in which machine a transport takes place of two rows (7, 8) of printed circuit boards situated next to one another, the printed circuit boards (2) lying with their T sides (Top sides) upward in the one row (7) and with their B sides (Bottom sides) upward in the parallel row (8), such that both rows of printed circuit boards are simultaneously transported through the placement machine, during which components are placed on the printed circuit boards in both rows. Printed circuits boards coming from the one row (7) are turned over and subsequently fed back to the adjacent row (8).

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# Method of processing printed circuit boards and device therefore.

The invention relates to a method of processing printed circuit boards which are transported consecutively through a number of processing stations, among which a component placement machine in which components are placed on a first side of a printed circuit board, after which the printed circuit board is turned over in a further processing station and is returned to said component placement machine for the placement of components on the other, second side of the printed circuit board.

EP-A-0 504 656 discloses a method of turning over a printed circuit board after a treatment of one side of this board in a processing machine and of returning it to that same processing machine for a treatment of the other side of the printed circuit board. This relates to a treatment with a liquid. It is also known, however, to apply such a method to the placement of components on both sides of a printed circuit board. In this method, a number of printed circuit boards is first transported through a component placement machine and provided with components at a first side, whereupon said printed circuit boards are stored, and are subsequently turned over in a later stage and supplied to the relevant placement machine again in order to be provided with components at the other, second side. The supply of printed circuit boards for the placement of components on the first side is interrupted during the placement of components on the second sides of the printed circuit boards. An advantage of this method is that only one placement machine is necessary. A disadvantage is, however, that it leads to a comparatively long cycle time for each printed circuit board, i.e. the time required for providing both sides of a printed circuit board with components, because there is no continuous flow of printed circuit boards, but the printed circuit boards are fed in batches. There is no efficient use of the machines in the process.

It is also known to carry out the placement of components at the second side by means of a second placement machine which is arranged in series with the first placement machine. The total cycle time of a printed circuit board is then determined by the longer of the two cycle times of the two machines. This can lead to a shorter cycle time than in the method mentioned above with one placement machine because waiting times are shorter. However,

two placement machines are necessary now, which has a cost raising effect.

It is an object of the invention to find a solution to the above disadvantages, i.e. to provide a method which saves cost and nevertheless has a short cycle time for the placement of components on both sides of a printed circuit board.

The invention is for this purpose characterized in that the printed circuit boards are transported simultaneously in two rows next to one another through the placement machine, the printed circuit boards in a first row lying with a first side facing upward and the printed circuit boards in the second row situated next to the first lying with the second sides facing upward, and components are placed on the printed circuit boards in both rows. A continuous flow of printed circuit boards now takes place in only one placement machine, so that components can be placed on the printed circuit boards in the first row with the first sides facing upward as well as on the printed circuit boards in the second row next to the first with the second sides facing upward. The waiting times for the robots which are to place the components can be minimized.

It can be noted that a method is known from EP-A-0 413 098 whereby printed circuit boards undergo an operation in a number of processing machines in series, the printed circuit boards being transported in parallel rows through one of the processing machines and being processed simultaneously. This is done when the operation on a printed circuit board in such a machine takes a considerably longer time than in the other machines, so that the waiting times of the other machines are reduced. This applies, however, to an operation on one side of the printed circuit boards.

In a preferred embodiment of the method, a robot first places components on printed circuit boards in the first row and subsequently the same type of components on printed circuit boards in the second row next to the first. The advantage of this is that only one magazine and one feed system for the components is necessary.

In another preferred embodiment of the method, a robot places components on printed circuit boards in the first row while simultaneously another robot places components on printed circuit boards in the second row next to the first. This offers the possibility of reducing the cycle time as compared with the preferred embodiment mentioned earlier. This is dependent, however, on the distribution of the number of

components to be placed on the one and the other side of the printed circuit board, and also on the type of components.

The invention also relates to a placement system for the implementation of the method mentioned above, comprising a component placement machine and a transport mechanism for transporting printed circuit boards in the placement machine, which transport mechanism is capable of transporting two rows of printed circuit boards situated next to one another through the placement machine, while the placement machine has a first and a second transport inlet and a first and a second transport outlet for the first and the second row of printed circuit boards, respectively, and is further provided with at least one robot for placing the components on printed circuit boards in both rows. According to the invention, this placement system is characterized in that it is provided with a turning device for turning over the printed circuit boards, the first transport outlet of the placement machine being connected to a transport inlet of the turning device and a transport outlet of the turning device being connected to the second transport inlet of the placement machine.

The invention will now be explained in more detail with reference to an embodiment shown in the drawings, in which

Fig. 1 diagrammatically shows a process sequence according to the invention, and

Fig. 2 diagrammatically shows a placement system in which a component placement machine with dual transport is used in the process sequence as depicted in Fig. 1.

The operation on printed circuit boards as shown in Fig. 1 proceeds as follows.

Unprocessed boards 2 are taken one by one from a magazine 1 by a transferrer 3 and placed on a transport belt, and subsequently transported to a silk-screen printing machine 4. One side of the printed circuit board, the T side (Top side) is provided with soldering paste 5 in the desired locations by the silk-screen printing machine. The printed circuit boards are then transported to a component placement machine 6. The placement machine has a transport mechanism capable of transporting two rows 7, 8 of printed circuit boards situated next to one another simultaneously. All printed circuit boards coming from the silk-screen printing machine are placed in a first row 7 and provided with components 9 in the placement

machine. The next processing station is an oven 10 in which the solder is made to flow, whereupon the components 9 are fixed with solder through cooling-down. Then wire components 12 are provided on the T side of the printed circuit board in station 11, and the printed circuit board is turned over in a turning device 13 so that the B side (Bottom side) faces upward now. In the next station 14, glue droplets 15 are provided for components yet to be placed. Then the printed circuit boards are returned with their B sides up to the placement machine 6 and arranged in the second row 8, next to the first row 7. A first row 7 with printed circuit boards with their T sides up and next to that a second row 8 of printed circuit boards with their B sides up are accordingly present in the placement machine now. Components 16 are placed on the B side, i.e. at the areas of the glue droplets. The printed circuit boards in the second row are subsequently transported to a curing oven 17 for curing the glue, turned over again in a turning device 18, and the components 16 and the wire components 12 are soldered to the B side in a wave soldering machine 19.

The essence of the process sequence here is that a transport of two rows of printed circuit boards next to one another takes place in the component placement machine, the boards lying with their T sides up in one row and with their B sides up in the row next to it, and that both rows of printed circuit boards are simultaneously transported through the placement machine, during which components are placed on the printed circuit boards in both rows. The printed circuit boards coming from the placement machine may or may not undergo various treatments before they are turned over and fed back to the placement machine.

The placement machine shown in Fig. 2 for the placement of components on printed circuit boards 2 comprises a component placement machine 6 with a transport mechanism 20 for transporting the printed circuit boards in the placement machine, and a turning device 13 for turning over the printed circuit boards 2. Two rows 7, 8 of printed circuit boards situated next to one another can be transported in the placement machine. The placement machine is for this purpose provided with a first transport inlet 21 and a first transport outlet 22 for the first row 7 of printed circuit boards, and a second transport inlet 23 and a second transport outlet 24 for the second row 8 of printed circuit boards. In the transport line 25 of printed circuit boards through the system, the first transport outlet 22 of the placement machine is connected to a transport inlet 26 of the turning device 13, while a transport outlet 27 of the turning device is connected to the second transport inlet 23 of the placement machine. Two rows of printed circuit boards are transported through the placement machine in this manner, the printed circuit boards in the first row 7 lying with

their T sides up and the printed circuit boards in the second row 8 lying with their B sides up. Components, for example SMDs (Surface Mounting Devices), are placed on the printed circuit boards by the robots. A large number of robots is present in the placement machine shown. One robot can here first place components on the T side of a printed circuit board in the first row 7 and subsequently the same type of component on the B side of a printed circuit board in the second row 8. It is also possible for the one robot to place components on printed circuit boards in the one row while simultaneously another robot places components on printed circuit boards in the other row. It will be obvious that many different possibilities exist in such an arrangement as to the sequence according to which components can be placed. The transport line 25 will usually comprise a number of processing stations as is already indicated, for example, in Fig. 1.

CLAIMS:

1. A method of processing printed circuit boards which are transported consecutively through a number of processing stations, among which a component placement machine in which components are placed on a first side of a printed circuit board, after which the printed circuit board is turned over in a further processing station and is returned to said component placement machine for the placement of components on the other, second side of the printed circuit board, characterized in that the printed circuit boards are transported simultaneously in two rows next to one another through the placement machine, the printed circuit boards in a first row lying with a first side facing upward and the printed circuit boards in the second row situated next to the first lying with the second sides facing upward, and components are placed on the printed circuit boards in both rows.

2. A method of processing printed circuit boards as claimed in Claim 1, characterized in that a robot first places components on printed circuit boards in the first row and subsequently the same type of components on printed circuit boards in the second row next to the first.

3. A method of processing printed circuit boards as claimed in Claim 1, characterized in that a robot places components on printed circuit boards in the first row while simultaneously another robot places components on printed circuit boards in the second row next to the first.

4. A placement system for placing components in printed circuit boards, comprising a component placement machine and a transport mechanism for transporting printed circuit boards in the placement machine, which transport mechanism is capable of transporting two rows of printed circuit boards situated next to one another through the placement machine, while the placement machine has a first and a second transport inlet and a first and a second transport outlet for the first and the second row of printed circuit boards, respectively, and is further provided with at least one robot for placing the components on printed circuit boards in both rows, characterized in that the placement system is provided with a turning device for turning over the printed circuit boards, the first transport outlet of the placement machine being connected to a transport inlet of the turning device and a transport outlet of the turning device being connected to the second transport inlet of the placement machine.

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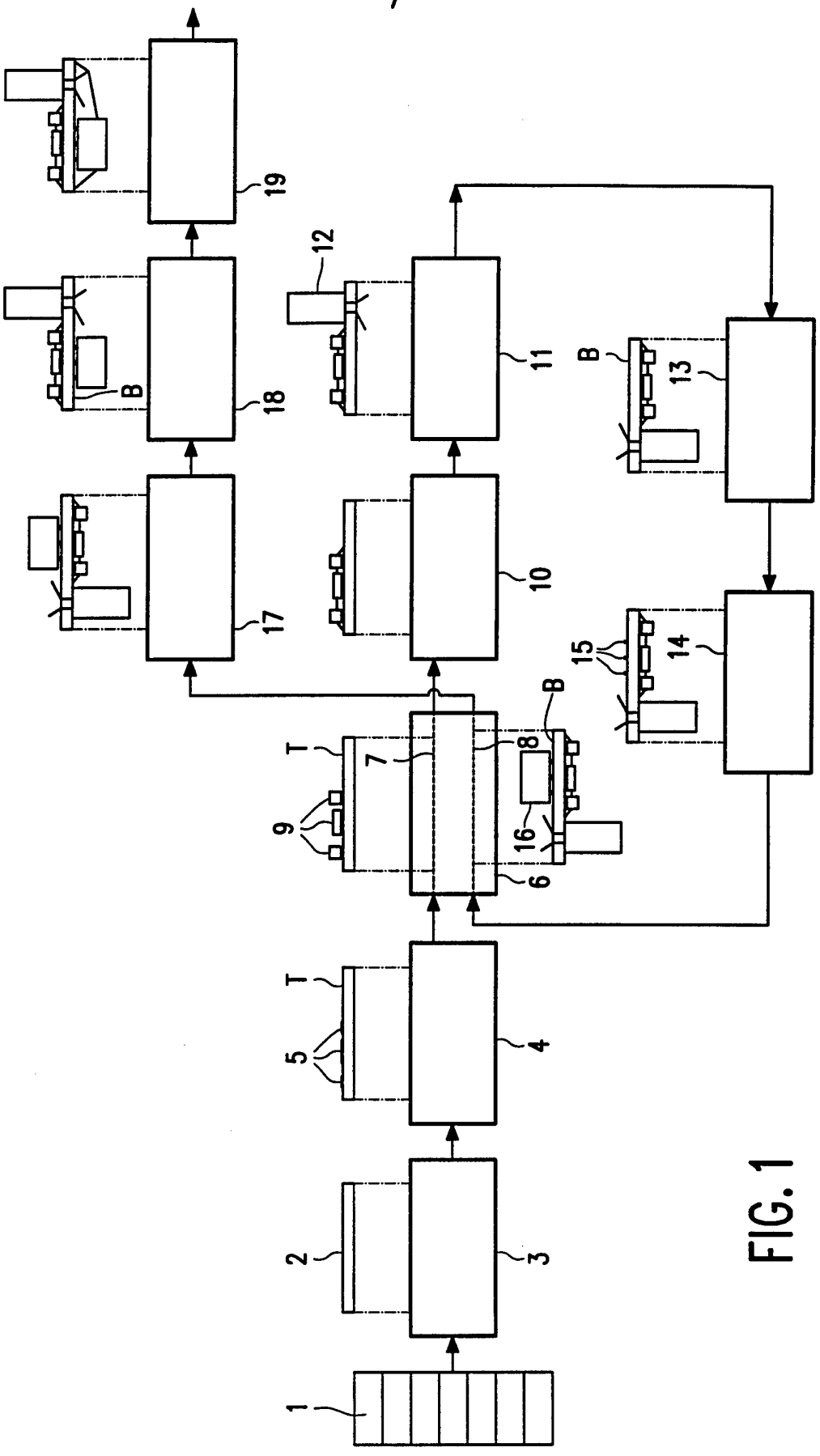


FIG. 1

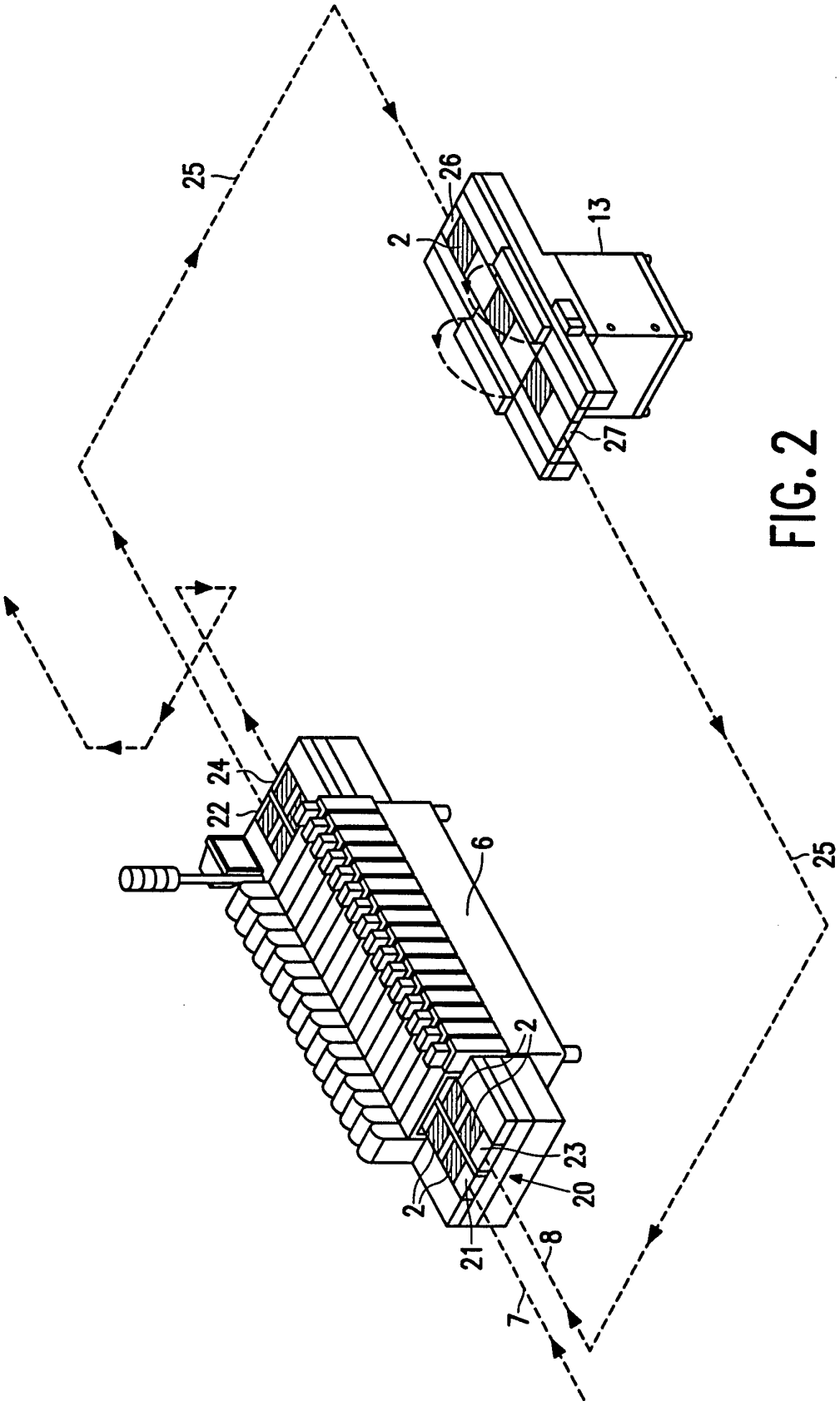


FIG. 2

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 96/00304

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H05K 13/04, H05K 13/00, H05K 13/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | EP 0504656 A1 (GEBR. SCHMID GMBH & CO.), 23 Sept 1992 (23.09.92), figure 1, abstract<br>-- | 1,4 |
| Y | Swedish Journal: Elteknik med aktuell elektronik, No. 12, August 1983, p. 9-11, Reidar Carlsson; "Ta bort benen på komponenterna", especially figure 2.<br>-- | 1,4 |
| A | EP 0413098 A2 (SCHERING AG), 20 February 1991 (20.02.91), abstract<br>--<br>-------- | 1,4 |

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

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