

The invention claimed is:

1. A pick and place device with automatic pick-up-height adjustment comprising:
 - a first pneumatic system including:
 - a first controllable valve connected with its input port to a first air flow source; and,
 - a second controllable valve connected with its input port to a vacuum source, wherein an output port of the first controllable valve and an output port of the second controllable valve are connected to a common tube which is in fluid communication with at least one vacuum nozzle of the pick and place device;
 - a second pneumatic system including:
 - an inlet valve and an outlet valve which are in fluid communication via a connecting tube, wherein an open air exhaust and a flow controller are arranged in the connecting tube between the inlet valve and the outlet valve; and,
 - a flow sensor, which is in fluid communication with the at least one vacuum nozzle via a tube.
2. The pick and place device as claimed in claim 1, wherein:
 - the input port of the inlet valve and an output port of the outlet valve of the second pneumatic system are connected to the common tube; and,
 - the flow sensor is arranged in the common tube after a connection of the output port of the outlet valve with the common tube.
3. The pick and place device as claimed in claim 1, wherein:
 - the open air exhaust is connected to an output port of the inlet valve of the second pneumatic system; and,
 - an outlet port of the air exhaust is connected to the flow controller, which is connected to an input port of the outlet valve of the second pneumatic system.
4. The pick and place device as claimed in claim 1, wherein an input port of the inlet valve of the second pneumatic system is connected via the common tube of the first pneumatic system to the first air flow source.

5. The pick and place device as claimed in claim 1, wherein:

the common tube of the first pneumatic system and the second pneumatic system are connected to a pneumatic distribution block;

a pressure sensor is mounted to the pneumatic distribution block; and,

an output of the distribution block is connected to the picker adapter via a tube.

6. The pick and place device as claimed in claim 5, wherein the second pneumatic system comprises a second air flow source, which is directly connected to an input port of the inlet valve of the second pneumatic system.

7. The pick and place device as claimed in claim 5, wherein:

a flow sensor is arranged as well in the connecting tube between the inlet valve and the outlet valve of the second pneumatic system; and,

the flow sensor is connected to an input port of the outlet valve.

8. The pick and place device as claimed in claim 1, wherein the common tube of the first pneumatic system and

the connecting tube of the second pneumatic system having a diameter between 2 to 3 mm.

9. The pick and place device as claimed in claim 1, wherein the flow sensor is electrically connected to a display for displaying an output signal of the flow sensor.

10. A method to automatically adjust the pick-up-height of a pick and place device comprising a first pneumatic system comprising a first air flow source and a second pneumatic system comprising a second air flow source, the method comprising the steps of:

moving a pick and place head of the pick and place device above at least one component in a cell of a JEDEC tray; opening an inlet valve and an outlet valve of the second pneumatic system, so that the second pneumatic system receives an air flow from the second air flow source; adjusting a flow rate in the second pneumatic system to a predefined level with a flow controller and an open air exhaust;

initiating at least one stepwise motion of the pick and place head in a Z coordinate direction in order to decrease a distance between a vacuum nozzle and a surface of the component in the cell of the JEDEC tray; and

storing a Z-position between the vacuum nozzle and the surface of the component, at which the flow rate, measured by a flow sensor falls below a predefined level.

11. The method of claim 10, further comprising: waiting a settling time before the flow rate is checked after each stepwise motion of the pick and place head in the Z coordinate direction; and, initiating, in case the flow rate is above a predefined level, a further stepwise motion.

12. The method of claim 10, further comprising: carrying out the relative motion in the Z-coordinate direction exclusively by a motor of the pick and place head; and storing a Z-motor position as an equivalent of the stored distance, at which the air flow from the second air flow source reaches the predefined flow rate and the stored distance is considered a pick-up height.

13. The method of claim 12, further comprising: calculating, from the pick-up height, a drop height so that the drop height is greater than the pick-up height.

14. The method of claim 10, further comprising: moving the pick and place head to an initial start height; closing the inlet valve and the outlet valve of the second pneumatic system; and, performing, with the pick and place head, a pick-up with the stored distance between the vacuum nozzle and the surface of the component.

15. The method of claim 14, further comprising:
providing a monitoring system to control pick-up quality;
and,
generating an error message if the pick-up quality does
not meet preset standards.

16. A computer program product disposed on a non-transitory computer readable medium to automatically adjust the pick-up-height of a pick and place device comprising first pneumatic system comprising a first air flow source and a second pneumatic system comprising a second air flow source, the product comprising:

computer executable process steps operable to control a computer to:

move a pick and place head of the pick and place device
above at least one component to be picked up;

open an inlet valve and an outlet valve of the second pneumatic system, so that the second pneumatic system receives an air flow from the second air flow source; adjust a flow rate in the second pneumatic system to a predefined level with a flow controller and an open air exhaust;

initiate at least one stepwise motion of the pick and place head in a Z coordinate direction in order to decrease a distance between a vacuum nozzle and a surface of the component; and,

store the Z-position between the vacuum nozzle and the surface of the component, at which the flow rate, measured by a flow sensor falls below a predefined level.

17. The computer program product disposed on a non-transitory computer readable medium of claim 16, wherein:

a predetermined time interval is waited after the opening of the an inlet valve; and,

the outlet valve of the second pneumatic system to allow the air flow from the second air flow source to reach the predefined flow rate.

18. The computer program product disposed on a non-transitory computer readable medium of claim 16, wherein:
a settling time is waited before the flow rate is checked after each stepwise motion of the pick and place head in the Z coordinate direction; and,
in case the flow rate is above a predefined level a further stepwise motion is initiated, and it is carried on until the flow rate measured by the flow sensor falls below a predefined level.
19. The computer program product disposed on a non-transitory computer readable medium of claim 16, wherein:
the relative motion in the Z-coordinate direction is carried out exclusively by a motor of the pick and place head; and,
a Z-motor position is stored as an equivalent of the stored distance, at which the air flow from the second air flow source reaches the predefined flow rate and the stored distance is considered a pick-up height.
20. The computer program product disposed on a non-transitory computer readable medium of claim 16, wherein
from the pick-up height a drop height is calculated so that the drop height is less than the pick-up height.
21. The computer program product disposed on a non-transitory computer readable medium of claim 16, wherein:
the pick and place head is moved to an initial start height;
the inlet valve and the outlet valve of the second pneumatic system are closed; and,
the pick and place head performs a pick-up with the stored distance between the vacuum nozzle and the surface of the component.
22. The computer program product disposed on a non-transitory computer readable medium of claim 21, wherein
the pick-up quality is controlled and an error message is generated if the pick-up quality does not meet preset standards.
23. A method to automatically adjust the pick-up-height of a pick and place device, which has a first pneumatic system comprising a first air flow source and a second pneumatic system comprising a second air flow source, the method comprising:

moving a pick and place head of the pick and place device to an initial start height above at least one component to be picked up;
 opening an inlet valve and an outlet valve of the second pneumatic system, so that the second pneumatic system receives an air flow from the second air flow source;
 waiting a predetermined time interval to obtain a constant flow rate over time at a predefined level, wherein the predefined level is set by a flow controller and an open air exhaust of the second pneumatic system;
 carrying out at last one stepwise motion of the pick and place head in a Z coordinate direction and thereby storing an actual Z-position of the pick and place head;
 measuring the flow rate after each stepwise motion and if the flow rate is below a predefined level the actual Z-position of the pick and place head is stored and defined as a pick-up height;
 closing the inlet valve and an outlet valve of the second pneumatic system;
 moving the pick and place head the initial start height;
 calculating a drop height, which is greater than the pick-up height of the component; and
 performing a pickup of at least one component.

24. The method of claim 23, further comprising:
 controlling the pick-up of at least one component; and
 generating an error message when the pick-up fails.

25. The method of claim 23, further comprising:
 controlling the pick-up of at least one component; and
 automatically continuing a production process when the pick-up is correct.