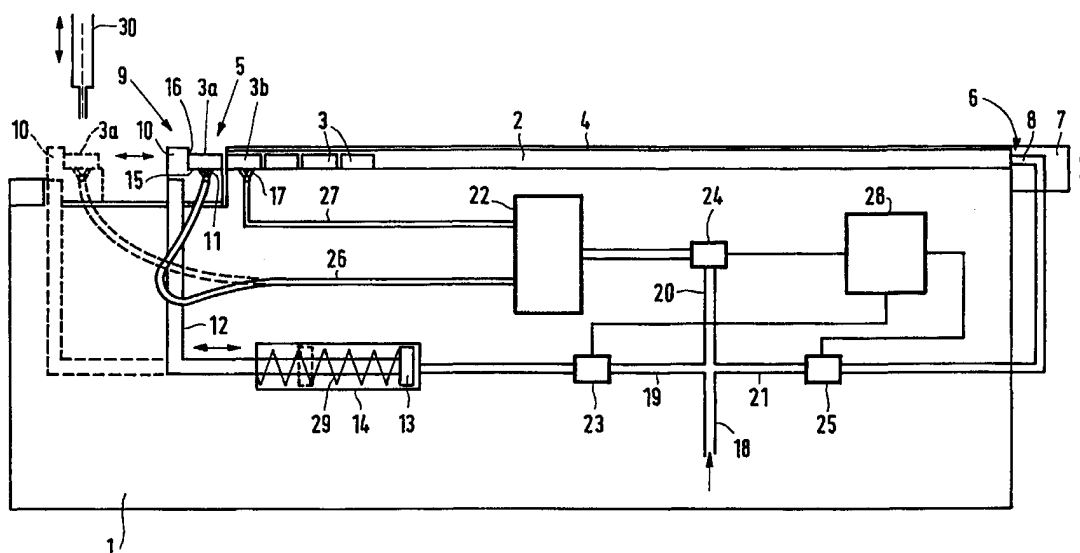




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(54) Title: COMPONENT SUPPLY AND SEPARATION APPARATUS AND METHOD OF SEPARATING A FIRST COMPONENT FROM A ROW OF COMPONENTS



(57) Abstract

The invention relates to a component supply and separation apparatus comprising a supply duct (2) in which components (3) are disposed one after the other in a row. The apparatus comprises a component separation head (10) disposed near an outlet (5) of the supply duct, which head is movable away from the outlet and towards the outlet of the supply duct. Both the separation head (10) and the supply duct (2) have a suction port, respectively for holding a first component (3a) of the row on the separation head and for holding the second component (3b) of the row in position in the supply duct. The invention also relates to a corresponding method.

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Component supply and separation apparatus and method of separating a first component from a row of components.

The invention relates to a component supply and separation apparatus comprising a supply duct in which components are disposed one after the other in a row, transport means for feeding components through the supply duct towards an outlet of the supply duct, a component separation mechanism disposed near the outlet of the supply duct and having a separation head, which is movable over a given distance away from the outlet of the supply duct and towards the outlet of the supply duct, which separation head has a suction port, the apparatus further comprising pneumatic means for creating a partial vacuum near the suction port to hold a first component of the row on the separation head.

Such an apparatus is known from US-A-4,953,749. In this known apparatus components from a storage chamber are arranged in a row in a supply duct by means of pressurized-air pulses. A component separation mechanism is disposed at the end of the supply duct and comprises a separation head which alternately moves away from and towards the end of the supply duct and which has a suction port to pick up a component from the row by means of a partial vacuum. A shutter mechanism is disposed at the end of the supply duct and comprises a pivotable lever provided with a shutter by means of which the outlet opening of the supply duct can be shut off. When an empty separation head is situated near the outlet opening the shutter is pivoted away, as a result of which the first component is drawn against the separation head by means of a partial vacuum in the suction port, after which the separation head moves away from the supply duct and the shutter is again pivoted to shut off the outlet opening. A problem which can occur with this system is that the separation head and the shutter do not always cooperate correctly because the pressurized-air pulses in the storage chamber also produce an air pressure in the supply duct, so that after the first component of the row has been drawn against separation head the second component of the row is urged directly against the first component, as a result of which the shutter cannot properly shut off the supply duct and the component jams, which is undesirable. Moreover, the component may be damaged. This can also occur when the first component is drawn onto the separation head and the second component is also drawn along a little and

thereby obstructs the shutter.

It is an object of the invention to improve the component supply and separation apparatus of the type defined in the opening paragraph so as to minimize the risk of problems during separation of the first component from the row, in such a manner that the supply of components to, for example, a component placement machine can be effected in a substantially trouble-free manner.

To this end, the component supply and separation apparatus is characterized in that near the outlet the supply duct has at least one suction port for holding the second component of the row in position in the supply duct.

This has the advantage that holding of the first component by the separation head and of the second component at the outlet of the supply duct can take place concurrently. Physical separation of the components is effected subsequently in that the separation head with the first component moves away from the outlet of the supply duct, while the second component in the supply duct remains in place (and now, in fact, becomes the first component in the supply duct). The separation of the components in such an apparatus is much less dependent on the shape and tolerance of components than in the case of the known separation apparatus.

Preferably, the separation head comprises a supporting surface and a stop surface for the component, which supporting surface has a suction port for holding a component in position. After the empty separation head has reached the end of the supply duct the components in the row are advanced until the first component is situated on the supporting surface of the separation head against the stop surface. Subsequently, a partial vacuum is produced both at the suction port in the separation head and at the suction port in the supply duct, as a result of which the first component (on the separation head) and the second component (at the outlet of the supply duct) are simultaneously held by suction. The separated component now lies on the supporting surface of the separation head, which is subsequently moved away from the supply duct. As a result of this, the component can be picked up more easily and reliably from the separation head by, for example, a suction nozzle of a placement head of a component placement machine.

A further embodiment of the component supply and separation apparatus is characterized in that an air injection block having a nozzle is connectable to the inlet of the supply duct, enabling pressurized-air pulses to be produced in the supply duct in order to

move the components through the supply duct, which pressurized-air pulses have a length of 80-200 ms, preferably 100-1400 ms, and a time interval of 20-100 ms, preferably 40-60 ms, between the pulses.

Preferably, the nozzle is adjustable in height with respect to the supply
5 duct.

The invention further relates to a method of separating a first component from a row of components situated in a supply duct, the first component being slid onto a separation head and subsequently being held on this head by means of a partial vacuum, while at the same time the second component is held in position in the supply duct, after
10 which the separation head is moved away from the supply duct and subsequently the partial vacuum is eliminated. According to the invention the second component is held in the supply duct in that the second component is drawn in position by suction.

15 The invention will now be described in more detail with reference to a diagrammatic drawing which shows an example of a component supply and separation apparatus.

20 The component supply and separation apparatus shown in the drawing has a frame 1, which accommodates a supply duct 2 for components 3. The open upper side of the supply duct is covered with a plate 4. In the supply duct the components are disposed one after the other in a row and they are conveyed to an outlet 5 of the supply duct from the right to the left in the Figure. The supply duct serves as a bar magazine for a large number
25 of components, for example SMDs (Surface Mounting Devices). For the transport of the components an air injection block 7 is disposed near the inlet 6 of the supply duct, which block has a nozzle 8 by means of which air pulses can be produced in the supply duct. The nozzle is adjustable in height, so that the air pulses can be directed to the inlet of the supply duct in an optimum manner. A separation mechanism 9 is disposed near the outlet 5 of the
30 supply duct and enables the first component to be removed from the row. In fact, this is where the first component 3a and the second component 3b of the row are separated from one another. The separation mechanism comprises a separation head 10 having a double suction port 11, in which a partial vacuum can be created. The separation head is slidably mounted on the frame 1 in line with the supply duct 2 downstream of the outlet 5 of the duct

and can be driven so as to reciprocate linearly over a given distance in the longitudinal direction of the supply duct. However, alternatively the separation head can be drivable transversely to the supply duct. The separation head is driven pneumatically. For this purpose, the separation head is connected to a piston 13 in a cylinder 14 by means of a rod

5 12. The separation head 10 has a supporting surface 15 for supporting a component and has a stop surface 16 at the end of the supporting surface. The separation mechanism further has a double suction port 17 in the supply duct near the outlet 5 of the duct. In both suction ports a partial vacuum can be formed in a controlled manner.

The pneumatic system comprises a central air supply line 18 from which
10 three air lines 19, 20, 21 lead to the cylinder 14, a vacuum pump 22 and the air injection block 7, respectively. The air lines 19, 20, 21 include valves 22, 24 and 25, respectively. From the vacuum pump 22 a line 26 extends to the double suction port 11 of the separation head 10 and a line 27 to the double suction port 17 near the outlet of the supply duct 2. The vacuum pump operates in accordance with the venturi principle. The valves are, for example,
15 electromagnetically controlled valves, which are controlled by a control circuit 28.

The supply and separation apparatus operates as follows: The nozzle 8 is directed to the inlet of the supply duct 2 in an optimum manner. Assuming that the empty separation head 10 is situated near the outlet 5 of the supply duct and all the valves are closed, a separation cycle is started by briefly opening the valve 25 in the air line 21 to the
20 injection block 7. As a result, some pressurized-air pulses are applied to the row of components 3. For example, three pressurized-air pulses may be applied with a length t_1 of 120 ms and a time interval t_2 of 50 ms between the pulses. The components in the row are advanced until the first component 3a on the supporting surface 15 contacts the stop surface 16 of the separation head 10. After the three pressurized-air pulses the valve 25 is closed and
25 the valve 24 in the air line 20 is opened, as a result of which a partial vacuum is formed near the suction ports 11 and 17 by means of the vacuum pump 22, the vacuum causing both the first component 3a on the separation head and the second component 3b near the outlet 5 of the supply duct to be held in position. Subsequently, the valve in the 23 in the air line 19 to the cylinder 14 is opened, which causes the piston 13 to be moved against the pressure of
30 the spring 29 and the separation head 10 to be moved away from the supply duct (to the left in the drawing). As a result of this, the first and the second component are separated from one another. When the separation head has reached the position shown in broken lines, the valves 23, 24 are closed again. Subsequently, a placement head 30 can pick up the component 3a from the supporting surface 15. The valve 23 in the air line 19 to the cylinder

14 is then closed again, as a result of which the spring 29 urges the piston 13 to the right and the separation head is moved to the outlet 5 of the supply duct 2. When the separation head has reached the outlet the valve 23 is closed again and a new cycle can start.

Claims:

1. A component supply and separation apparatus comprising a supply duct in which components are disposed one after the other in a row, transport means for feeding components through the supply duct towards an outlet of the supply duct, a component separation mechanism disposed near the outlet of the supply duct and having a separation
5 head, which is movable over a given distance away from the outlet of the supply duct and towards the outlet of the supply duct, which separation head has a suction port, the apparatus further comprising pneumatic means for creating a partial vacuum near the suction port to hold a first component of the row on the separation head, characterized in that near the outlet the supply duct has at least one suction port for holding the second component of the row in
10 position in the supply duct.
2. A component supply and separation apparatus as claimed in Claim 1, characterized in that the separation head comprises a supporting surface and a stop surface for the component, which supporting surface has a suction port for holding a component in position.
- 15 3. A component supply and separation apparatus as claimed in Claim 2, characterized in that an air injection block having a nozzle is connectable to the inlet of the supply duct, enabling pressurized-air pulses to be produced in the supply duct in order to move the components through the supply duct, which pressurized-air pulses have a length of 80-200 ms, preferably 100-1400 ms, and a time interval of 20-100 ms, preferably 40-60 ms,
20 between the pulses.
4. A component supply and separation apparatus as claimed in Claim 3, characterized in that the nozzle is adjustable in height with respect to the supply duct.
5. A method of separating a first component from a row of components situated in a supply duct, the first component being slid onto a separation head and
25 subsequently being held on this head by means of a partial vacuum, while at the same time the second component is held in position in the supply duct, after which the separation head is moved away from the supply duct and subsequently the partial vacuum is eliminated, characterized in that the second component is held in the supply duct in that the second component is drawn in position by suction.

