

[54] **METHOD OF CLEANING FOREIGN MATTER FROM A CAVITY IN A SEMICONDUCTOR**[75] Inventors: **Terrence Maahs, Kanata; Dieter Marx, Stittsville, both of Canada**[73] Assignee: **Montreal, Montreal, Quebec, Canada**[22] Filed: **July 12, 1974**[21] Appl. No.: **488,063**[52] U.S. Cl. **134/21; 134/22 R; 134/37**[51] Int. Cl.² **B08B 5/02; B08B 5/04; B08B 7/04; B08B 9/00**[58] Field of Search **134/21, 37, 22 R; 15/345, 15/346****References Cited****UNITED STATES PATENTS**

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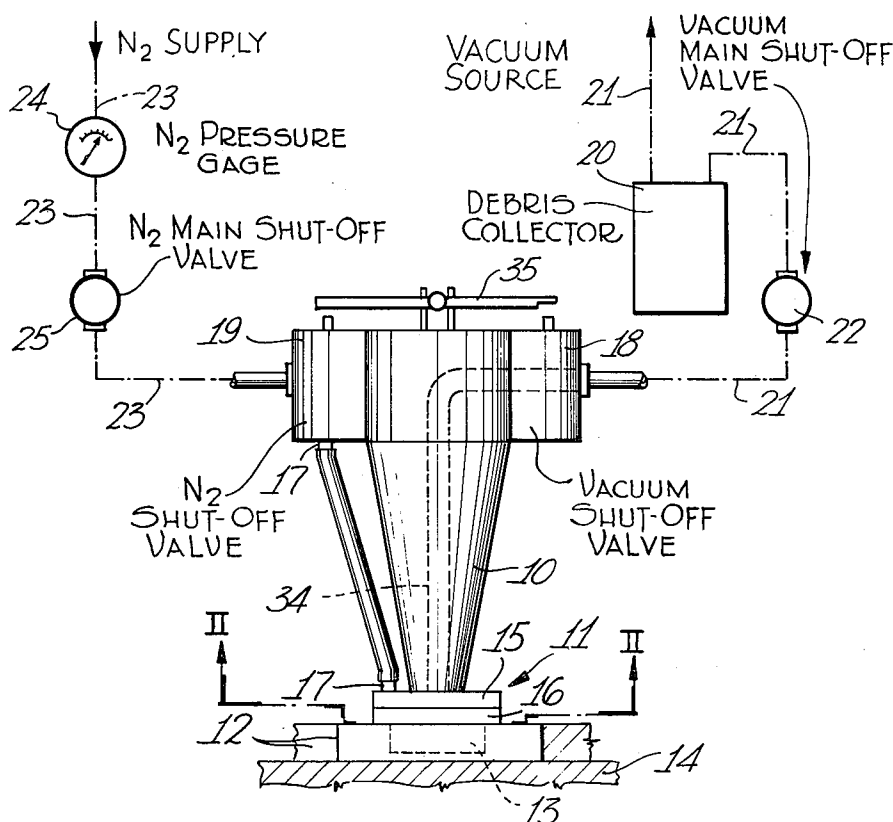
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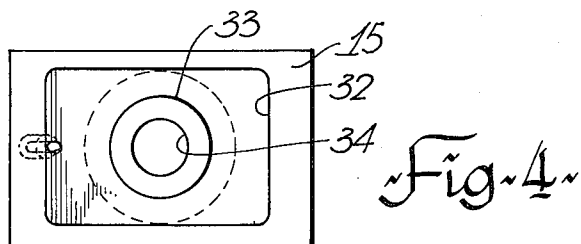
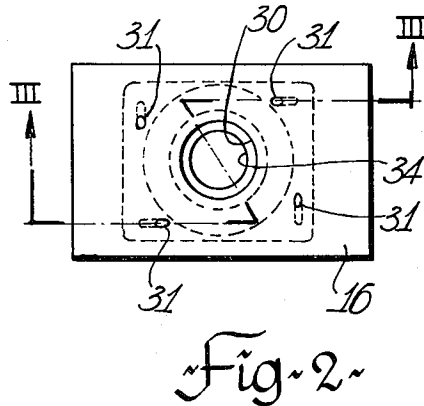
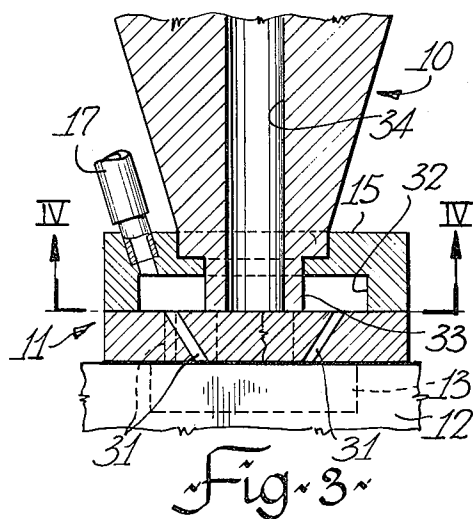
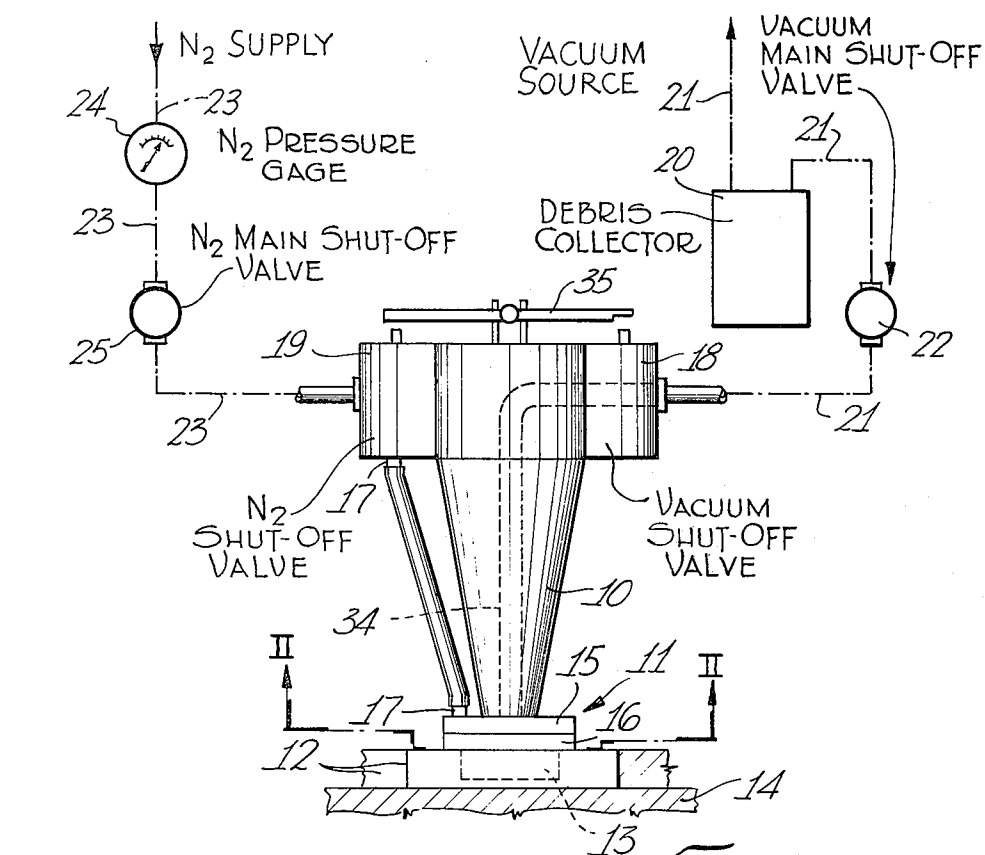
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A cleaning tool for removing loose foreign matter from cavities in devices, especially in electronic devices, the tool including a head which has a central vacuum or suction inlet and a series of pressurized gas outlets or jets positioned around the vacuum inlet. The gas outlets are inclined and eject the gas generally tangentially of the vacuum inlet to create a swirl. Preferably the gas supply is shut-off slightly before the vacuum or suction. The head rests on the device and seals the cavity, and the gas outlets are preferably positioned adjacent the periphery of the cavity.

3 Claims, 4 Drawing Figures



METHOD OF CLEANING FOREIGN MATTER FROM A CAVITY IN A SEMICONDUCTOR

This invention relates to a cavity cleaning tool and is particularly concerned with a tool for cleaning cavities of electronic devices, and to the method of operation of the tool.

In electronic devices, particularly semiconductors and similar devices, which are to be packaged after manufacture, the presence of loose foreign matter in any cavity may cause electrical shorting between two unpassivated areas, or between leads or similar situations.

The present invention provides for a tool, and a method of operating the tool, whereby any loose foreign matter is removed from a cavity. Broadly the tool comprises a cleaning head having a central vacuum inlet and a series of peripherally positioned pressurized gas outlets, the outlets angled to produce swirl, together with control valves and actuating means for applying and shutting off vacuum and pressurized gas flow to the head, in a predetermined sequence. Conveniently the cavity in a device is sealed by the cleaning head of the tool.

The invention will be readily understood by the following description of one embodiment, by way of example, in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic illustration of the apparatus;

FIG. 2 is a bottom plan view of the base of the tool head, on the line II—II of FIG. 1;

FIG. 3 is a cross-section on the line III—III of FIG. 2;

FIG. 4 is a bottom plan view of a part of the tool head, on the line IV—IV of FIG. 3.

Referring to FIG. 1 a cleaning tool is indicated at 10, having a cleaning head 11. The head 11 rests on a device 12 in which there is a cavity 13 to be cleaned. The devices 12 slide on and are supported by a support 14. As will be described in more detail later with reference to FIGS. 2 to 4, the head 11, in the present example, comprises two plates 15 and 16, plate 16 having a central aperture for suction and peripherally positioned pressurized gas jets. Plate 15 has a cavity to which pressurized gas is fed via pipe 17, the cavity feeding the pressurized gas to the gas jets in plate 16.

Mounted on the tool 10 are two shut-off valves 18 and 19. Valve 18 controls the vacuum connection to the central suction aperture of plate 16 via a bore in the body of the tool 10 and valve 19 controls the supply of pressurized gas to plate 15, via the pipe 17. A debris collecting chamber 20 is inserted in the vacuum line 21, and also a main shut-off valve 22. In the pressurized gas line 23, is a pressure gauge 24 and a main shut-off valve 25.

The cleaning head is illustrated in more detail in FIGS. 2, 3 and 4. As described above, the tool 10 has a tool head 11 comprising two plates 15 and 16. The lower plate 16, seen in bottom plan view in FIG. 2 has a central aperture 30 and four gas outlets or jets 31 positioned around the central aperture 30. The lower plate 16 fits tightly against the upper plate 15. Plate 15 has a large cavity or recess 32 to which pressurized gas is fed via pipe 17.

The outlets or jets 31 in plate 16 communicate at their upper ends with the cavity 32. The jets 31 are inclined so as to eject the pressurized gas with a swirl, the

gas being ejected in a somewhat tangential direction relative to the central aperture 30.

The plate 15 is a close fit on a cylindrical portion 33 at the lower end of the tool and the bottom surface of portion 33 is in firm contact with the upper surface of the lower plate 16. The tool 10 has a central bore 34 which at its lower end is in communication with the central recess 30 of plate 16. At its other end bore 34 is connected to the vacuum line 21 via the vacuum shut-off valve 18.

The apparatus is operated as follows. The tool is lowered over a device, indicated in chain dotted outline at 12 in FIG. 3. The lower face of plate 16 seats down on the upper surface of the device 12. Vacuum is applied to the cavity of the device, the cavity indicated in chain dotted outline at 13 in FIG. 3. The vacuum is started by opening shut-off valve 18. A pressurized gas, for example nitrogen, is then applied to the jets or outlets 31 via gas line 23, valve 19, pipe 17 and cavity or recess 32. The gas is ejected at an angle to create swirl which detaches any unattached foreign matter, which matter is then removed by the suction created by the vacuum applied via central recess 30. The gas flow is maintained for a predetermined period, and as an example a flow for a period as short as approximately two seconds has given satisfactory results.

The gas flow is then shut-off, by valve 19, followed by shutting off of the vacuum or suction by valve 18. The tool is then removed from the device. This sequence has been found to give good results as any particles which were still moving in the cavity were removed by the suction. This sequence can be obtained by a pivotally mounted control lever 35 which is arranged to actuate valve 19 prior to actuation of valve 18. A typical pressure range for the gas is 25–35 lb./sq.in. and for the vacuum 26–30 inches mercury. The jets or outlets, in a particular example, were 0.025 inch diameter and inclined at an angle of 15° from the vertical. The outlets 31 are arranged to be within, but, close to, a peripheral outline or contour which corresponds to the size and shape of the cavity 13 in the device 12. Thus it is possible to provide heads 11 having different sizes and also different arrangements of outlets or jets 31, to suit differing sizes and shapes of cavities in devices.

The gas flow from the central bore 34 passes via the valve 18 and the vacuum lines 21 to the debris collector 20. The gas supply to the jets 31 is controlled by two shut-off valves 19 and 25 and also the pressure is set at the gas supply for example at the cylinder outlet for nitrogen. The plates 15 and 16 of the tool head can be held together by screws or permanently connected together as by adhesive or other means. The plates are held on the lower end of the tool by frictional engagement with the cylindrical portion 33.

What is claimed is:

1. A method of cleaning loose foreign matter from a cavity in a semiconductor device, comprising:

positioning a cleaning head over a semiconductor device, a surface on said cleaning head seating on a surface of the semiconductor device around the cavity in the device, said cleaning head having a central inlet and a plurality of outlets positioned around said central inlet, said outlets and said central inlet positioned over said cavity;

ejecting pressurized gas from said outlets in a direction tangential to said central inlet;

applying a suction to said central inlet, and controlling the flow of pressurized gas to said outlets and

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the application of said suction to said inlet in a pre-determined sequence and time program to shut off the flow of pressurized gas before shutting off said suction.
2. A method as claimed in claim 1, including ejecting the pressurized gas at positions adjacent the periphery of the cavity.

3. A method as claimed in claim 1, including supplying the pressurized gas at a pressure of from 25 to 35 lb./sq.in. for a time of less than 5 seconds, and wherein the applied suction creates a vacuum of from 26-30 inches mercury.

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