United States Patent

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[54] **POLISHING MACHINE**
9 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **51/131**
[51] **Int. Cl.** **B24b 5/00**
[50] **Field of Search** 51/129, 131

[56] **References Cited**

UNITED STATES PATENTS

1,937,459	11/1933	Hill	51/131
1,763,647	6/1930	Danner	51/131
3,050,910	8/1962	Lichtenfeld	51/131 X
2,151,473	3/1939	Hulbert	51/131 X
3,377,750	4/1968	Day	51/131

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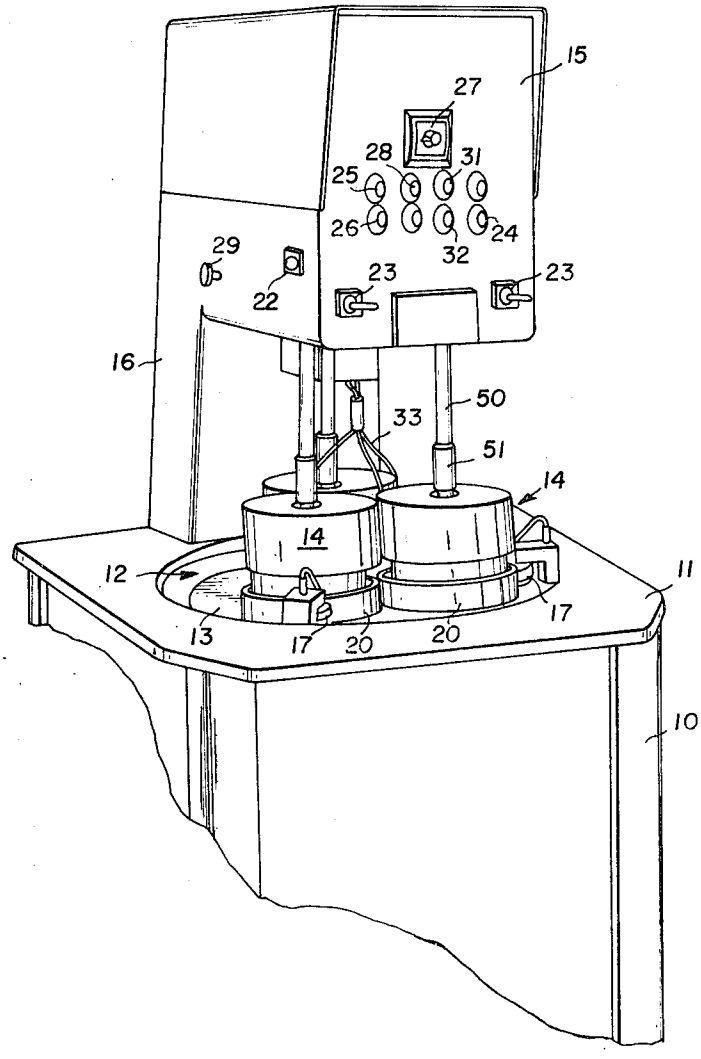
ABSTRACT: A polishing machine or similar abrading apparatus having a horizontal platen rotatable about a vertical axis with workpieces held against the platen by at least one vertically movable support head. Pneumatic means are provided to raise and lower the support head with the pneumatic means operatively disengaged from the support head in the operating position, and with adjustable dead weight means and position aligning idlers controlling the pressure and position of the support head during operation.



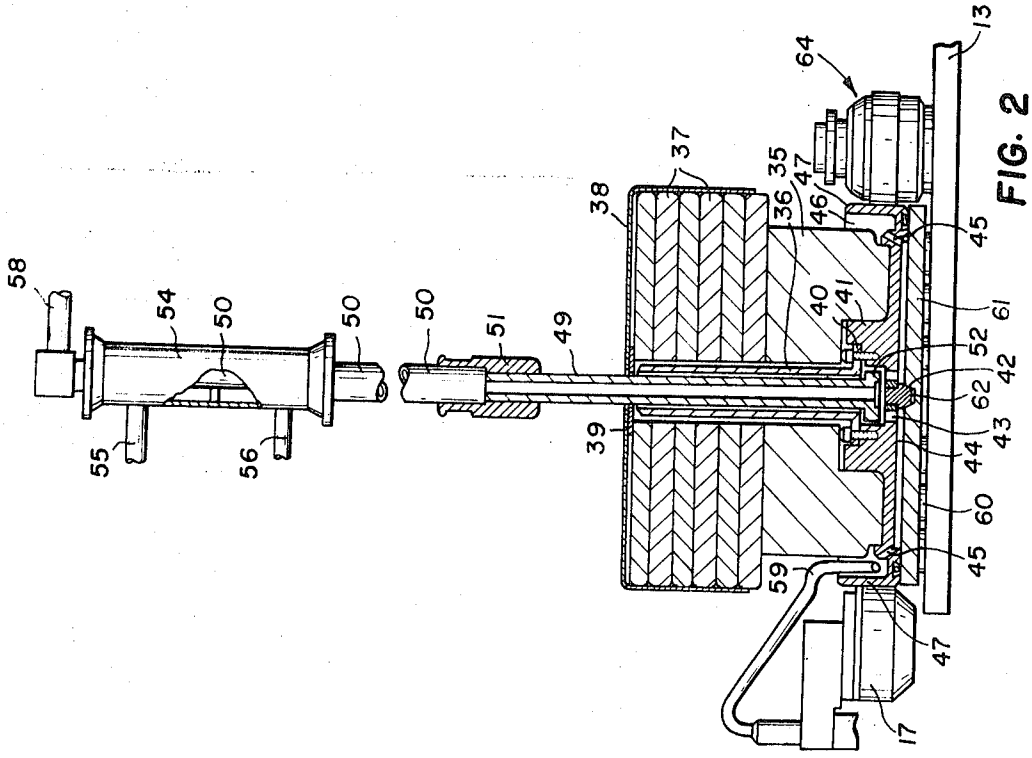


FIG. 2

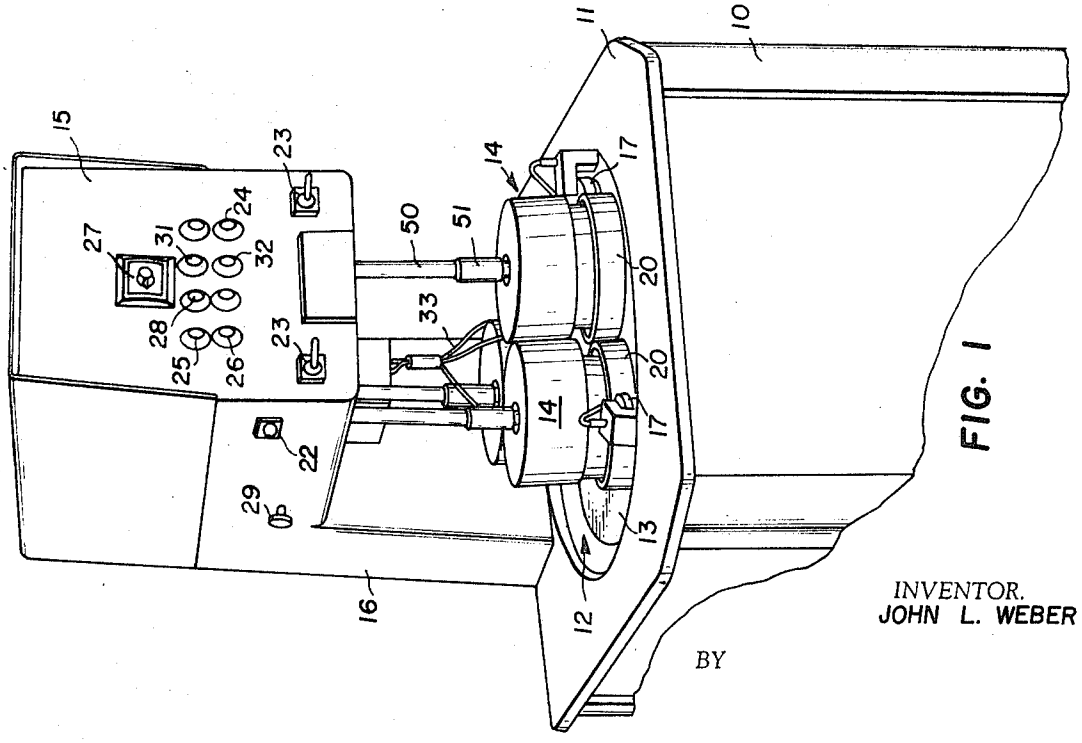


FIG. 1

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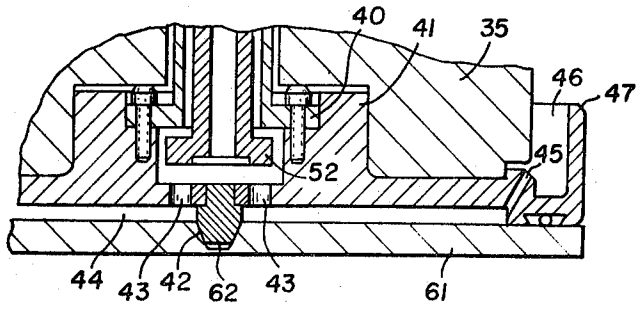

FIG. 3

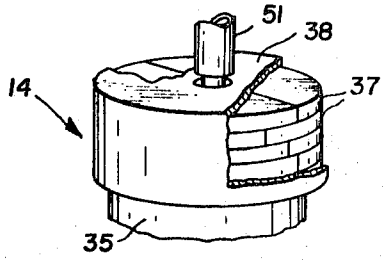

FIG. 5

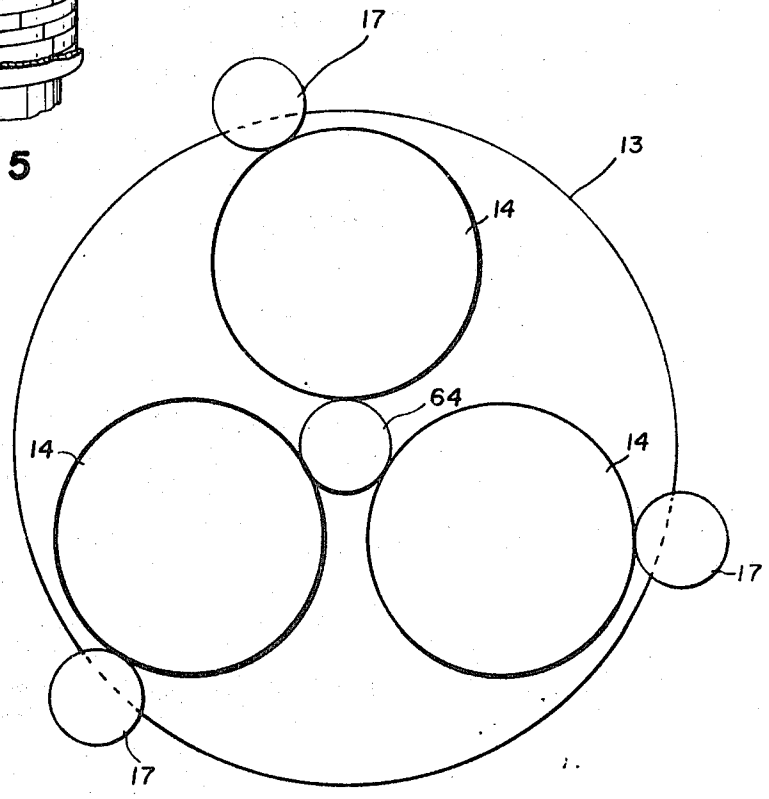

FIG. 4

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POLISHING MACHINE

Cross-reference is made to copending applications Ser. No. 862,219, entitled "Polishing Machine or Similar Abrading Apparatus," filed on Sept. 30, 1969, in the names of John L. Weber and Carl J. Vella; and Ser. No. 862,423, entitled "Polishing Machine or the Like with a Removable Platen," filed On Sept. 30, 1969, in the names of John L. Weber and George C. Klimas.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to abrading apparatus such as polishing machines, and in particular to workpiece support heads in the machines to provide the desired pressure between the workpieces and the abrading surface during operation.

2. Description of the Prior Art

When polishing workpieces such as silicon or germanium semiconductor wafers, it is important that the workpiece support heads maintain a preselected constant pressure between the workpieces and the abrading surface. At the same time, it is highly desirable to have automatic means for raising and lowering the support heads between polishing operations. Heretofore, certain kinds of lapping machines with pneumatic lifting means and designed for other purposes have been modified to perform such polishing operations, but operation has not been at the uniform pressures for extended periods of time because the pneumatic means also are used to apply the pressure.

SUMMARY OF THE INVENTION

According to the present invention, adjustable dead weight means are provided to apply the uniform, desired pressure to the workpieces and abrading surface through the support heads, and lifting means such as a pneumatic cylinder is provided to raise and lower the support head. The lifting means for each supporting head specifically is designed to be disengaged from the head during operation, and aligning idlers are provided to maintain position of the support head and workpieces during operation.

BRIEF DESCRIPTION OF THE DRAWING

The invention as well as objects and advantages thereof will become more apparent from the course of the following description of a preferred embodiment, the accompanying drawing forming a part thereof and wherein:

FIG. 1 is a partial perspective view of a polishing machine embodying the present invention;

FIG. 2 is a partial elevational view showing a workpiece support head and lifting means according to the invention in cross section;

FIG. 3 is an enlarged cross sectional view of the portion of the support head where the lifting mechanism is operatively engaged;

FIG. 4 is a partial top view showing the center idler and an end idler aligned with a support head during operation; and

FIG. 5 is a partial view showing the adjustable weight means.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a polishing machine incorporating the present invention suitably includes a support frame 10 on top of which is mounted a worktable 11 about waist high to an operator. The worktable 11 defines a central circular opening 12 within which is located a horizontally disposed circular platen assembly 13 rotatable about a central vertical axis. Workpieces are positioned on the top surface of the platen assembly 13, or a polishing pad covering the platen, and are held against the platen by a plurality (three) of work-supporting heads 14 which are vertically movable by a pneumatic system located in a control head unit 15 supported by a hollow column 16 forming part of the frame 10. In the operating position as shown in FIG. 1, a plurality (also three) of peripheral

or end idlers 17 frictionally engage collars 20 on support heads 14 to transmit uniform working rotational motion to all of the workpieces.

The control unit 15 contains suitable control device means to operate the polishing machine, such as a pneumatic control knob 22 for each support head 14 to raise and lower the head, fluid valves 23 to control the flow of cooling fluid such as water through the support heads, a slurry feed button 24 which provides a polishing compound in the form of a slurry to be pumped from a reservoir and metered onto the work surface of the platen through flexible tubes 33, machine start and stop buttons 25, 26, a timer 27 and timer reset button 28 and an emergency stop 29. The side of the control head not shown includes two pneumatic control knobs 22, a water valve 23 and an emergency stop 29. Additional control buttons may include a refrigerating unit start button 31 and a circulating water pump or aspirator control button 32.

According to the present invention, each support head 14 is designed to provide a uniform operating pressure and remove heat generated during a polishing operation. As shown in FIG. 2, the head 14 comprises a main body portion 35 having a central bore within which is located a hollow tube 36. The tube 36 extends above body portion 35 to define a reference post for attaching a plurality of semicylindrical weights 37, which are added or removed to adjust the level of working pressure desired. A lightweight cylindrical cap 38 overlies the weights 37 to keep them on portion 35 while the head rotates. The cap 38 is lifted to add or remove the weights as desired and includes a central retaining washer 39 engaging the top of tube 36 to limit its lowering to the position shown.

The lower end of tube 36 defines a flange 40 which is fixed by bolts or the like to a collar portion 41. Fixed to the center of collar 41 is an aligning stud 42, around which are located a plurality of ports 43 which provide fluid communication to the lower surface 44. The lower surface 44 is recessed as shown, and at the periphery of the recess are a plurality of fluid ports 45 to direct fluid from the lower surface to an annular space 46 defined by body portion 35 and the outer wall 47 of collar 41.

Within tube 36 is a hollow lifting tube 49 connected at its upper end to a hollow pneumatic piston rod 50 by a joint coupling 51. The lower end of tube 49 defines a flange 52 which engages flange 40 on tube 36 to raise the head 14 when tube 49 is lifted. In the down position as shown, flange 52 is spaced from flange 40 and body portion 35 such that the pneumatic control system does not affect the head pressure determined by weights 37. In this manner, the support head is permitted to "float" with variations in the platen level and in workpiece thicknesses to assure uniform polishing without excessive or uneven wear at "high spots."

The pneumatic system includes a cylinder 54 and suitable air pressure lines 55, 56 connected to a known air pressure source (not shown) by a valve controlled by knob 22 to selectively raise or lower the piston 50. As described more fully in U.S. application Ser. No. 862,219, filed Sept. 30, 1969, a flexible water line 58 connects the top portion of piston 50 to supply coolant water to the head through tube 49, with the water being removed from space 46 by a nozzle 59 connected to an aspirator pump.

To operate the machine, workpieces 60 (e.g. silicon wafers) are attached to the lower surface of a disc-shaped mounting block 61 by a known adhesive such as wax. The block 61 is then placed on platen assembly 13 below a head 14 with the workpieces 60 against the platen surface. The upper surface of block 61 defines a centering hole 62 which is engaged by stud 42 when the head 14 is lowered to align the block 61 with head 14.

As is described in copending application Ser. No. 862,219, and U.S. application Ser. No. 862,432, also filed Sept. 30, 1969, the platen assembly 13 is rotatable on a horizontal plane about a vertical axis coincident with a center idler assembly 64. A polishing pad may be adhesively mounted on the top surface of the platen assembly 13, and the top portion of

platen 13 is removable to replace the pad. The blocks 61 are placed on the platen assembly 13 while it is stopped, and each support head 14 is lowered until its collar portion 41 engages the appropriate mounting block to apply pressure between the workpieces 60 and the platen assembly 13. In the lowered position as shown in FIG. 3, collar portion 47 frictionally engages center idler 64 and an end idler 17.

When the lower platen assembly 13 is started, the differential linear motion against the workpieces is transferred to the support heads 14. The support heads 14 align themselves against their respective idlers, and center idler 64 by engaging all three collars 41 ensures that the workpieces under all three support heads describe a uniform planetary motion.

During operation the spacing between the piston tube 49 and support head tube 36, and their respective flanges 52, 40, enables the support head to adjust to the workpieces and to account for irregularities in motion. Frictional engagement with the idlers also permit changes in vertical and angular alignment of the support heads during rotation. Each work support head has a predetermined dead weight which is applied to the workpieces uniformly through mounting block 61. Since the lifting means is mechanically disengaged from the support head during operation, this weight, which should be kept constant, therefore is not affected by changes in, for example, air line pressure or workpiece thickness. If more or less weight is required for a given polishing run, the cap 38 is raised and the weights 37 of predetermined value are added or removed, preferably in pairs to maintain weight uniformity.

Thus, it can be seen that uniform and efficient work support means have been provided to polishing machines or similar abrading apparatus of the class described.

While the invention has been described by reference to a preferred embodiment, it is evident that changes or modifications, for example with respect to size, shape or arrangement of parts, may be resorted to without departing from the spirit of the invention.

I claim

1. Abrading apparatus comprising a horizontal platen assembly for supporting workpieces to be abraded and rotatable about a vertical axis, at least one workpiece retaining support head for constraining movement of workpieces relative to the platen assembly, the support head defining a central bore and having a predetermined body weight for applying an operating pressure between the workpieces and the platen assembly, and control means comprising a lifting tube in the bore with a flange engageable with the head for selectively raising and lowering the support head, the control means being operatively disengaged from the support head by being spaced from and out of engagement with the head when the head is lowered for operation such that the control means does not affect the support head weight during operation.

2. Abrading apparatus according to claim 1 wherein the control means comprises a pneumatic piston and cylinder assembly and the lifting tube comprises an extension of the piston and cylinder assembly.

3. Abrading apparatus according to claim 1 and further comprising means to add predetermined body weight and thereby increase the operating pressure.

4. Abrading apparatus according to claim 3 wherein the weight adding means comprises a liftable cap over the support head to receive within the cap a plurality of removable weights to be positioned on the support head.

5. Abrading apparatus according to claim 1 wherein the support head comprises a body portion defining the central bore and a mounting tube within the bore the lifting tube positioned within the mounting tube with the lifting tube flange below and engageable with the mounting tube, the lifting tube and lifting tube flange being spaced from the mounting tube when the head is lowered to permit motion of the support head relative to the lifting tube.

6. Abrading apparatus according to claim 5 wherein the support head further comprises a collar portion below the body portion to engage a workpiece mounting block when the head is lowered, and flange means for fixing the mounting tube to the collar portion.

7. Abrading apparatus according to claim 6 and further comprising a pair of idlers frictionally engaging the support head collar portion when lowered to align the position and rotation of the head with respect to the platen assembly.

8. Abrading apparatus according to claim 7 and comprising a plurality of support heads with one idler common to and frictionally engaging the collar portions of all the support heads to provide uniform rotation of the support heads.

9. Abrading apparatus according to claim 8 wherein the common idler is mounted on the platen assembly on its axis of rotation and the support heads are disposed over the platen assembly around the common idler with one other idler for each head at the periphery of the platen assembly.

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