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(71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 11445 Compaq Center Drive W., Houston, Texas 77070 (US).

(72) Inventor: **TURNER, Buck F.**; 1070 NE Circle Blvd., Corvallis, Oregon 97330-4239 (US).

(74) Agents: **WU, Bruce** et al.; Hewlett-Packard Company, Intellectual Property Administration, 3404 E. Harmony Road, Mail Stop 35, Fort Collins, Colorado 80528-9599 (US).

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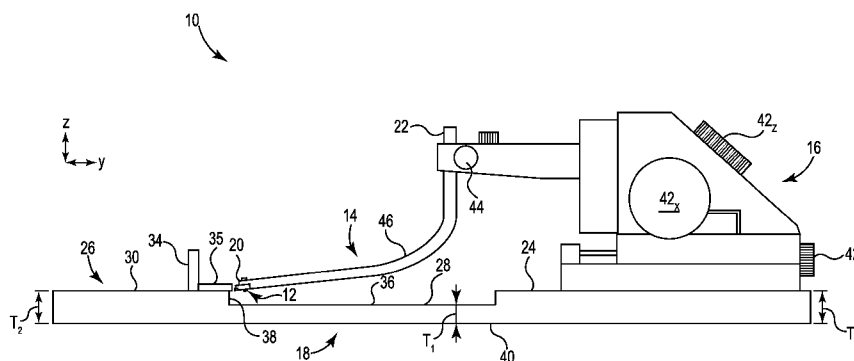
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- as to the identity of the inventor (Rule 4.17(i))
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(54) Title: SCRIBING TOOL

**Fig. 1**

(57) Abstract: Provided in one example is a scribing tool that includes a scribe tip having a scribing surface, an arm having a proximal end and a distal end, the scribe tip disposed at the distal end, a positioner including a coupler to couple with the proximal end and adjusters to movably position the scribe tip, and a platform including a positioner mounting portion, a specimen mounting portion, and a recessed area between the positioner mounting portion and the specimen mounting portion, the positioner disposed at the positioner mounting portion, and the distal end extending toward the specimen mounting portion.



SCRIBING TOOL

Background

[0001] Scribe cutting utilizes stress upon a scribing tool to create a micro-fracture within a specimen, often a semiconductor wafer, along a scribe line or cut. The scribe line creates a stress concentration that can cause crack propagation. The depth of the cut is relatively shallow and, if aligned properly, allows the specimen to be separated, or cleaved, along the specimen's natural crystal planes.

[0002] A semiconductor wafer includes several thin layers of insulating and conducting materials deposited sequentially on the workface of a semiconductor substrate. Manufacturing processes include quality controls for cross-sectioning along a scribe line and inspecting selected target features on the workface of the wafer. The scribe line of the wafer may coincide with the target feature to permit inspecting the target feature for quality control purposes.

Brief Description of the Drawings

[0003] Figure 1 is a side view of a scribing tool in accordance with an example.

[0004] Figure 2 is a top view of the scribing tool illustrated in Figure 1 in accordance with an example.

[0005] Figure 3 is a view of scribing system in accordance with an example.

[0006] Figure 4 is an exploded perspective view of a scribe tip adjacent to a specimen mounting platform of a scribing tool in accordance with an example.

[0007] Figure 5 is a flow chart illustrating an example of a scribing process.

[0008] Figures 6A-6E are diagrammatic illustrations of a scribing process in accordance with an example.

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Detailed Description

[0009] In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific examples in which the disclosure may be practiced. It is to be understood that other examples may be utilized and structural or logical changes may be made without departing from the scope of the present disclosure. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present disclosure is defined by the appended claims. It is to be understood that features of the various examples described herein may be combined, in part or whole, with each other, unless specifically noted otherwise.

[0010] Scribing systems and tools can be complex and expensive. Some scribing systems and tools include vacuums, lasers, or electronic controls. Complexity in setting up the systems and tools for operation and the placement of specimens that are to be scribed can lead to the systems and tools being used incorrectly or to users being dissuaded from using the systems and tools. Some methods and systems used in scribe cutting can be time consuming, inaccurate, and dependent on the proficiency of the operator.

[0011] Example scribing tools and systems, according to aspects of this disclosure, can provide ease and efficiency of forming scribe lines. An example scribing tool 10 for scribing specimens such as semiconductor wafers is illustrated in Figure 1. Scribing tool 10 includes a scribe tip 12, an arm 14, a positioner 16, and a platform 18. In general terms, scribe tip 12 is mounted on a distal end 20 of arm 14 and a proximal end 22 of arm 14 is connected to positioner 16 that movably positions scribe tip 12. Positioner 16 is mounted on platform 18.

[0012] With additional reference to Figure 2, platform 18 includes a positioner mounting portion 24, a specimen mounting portion 26, and a recessed portion 28 extending between positioner mounting portion 24 and specimen mounting portion 26. Specimen mounting portion 26 has a planar top surface 30. A series, or pattern, of holes 32 are open at top surface 30 and extend within

specimen mounting portion 26 from top surface 30. Holes 32 can extend partially or fully through the thickness of specimen mounting portion 26. Holes 32 are sized and shaped to receive pins 34. Holes 32 can be circular, square, or other suitable shape to accommodate removably receiving and securing pins 34. Holes 32 are arranged in a pattern. For example, an array of holes 32 can be arranged in a series of lines, with every other line offset from the adjacent line of holes 32. Holes 32 are positioned to provide flexibility to accept, position, and secure various sizes of specimens 35 on specimen mounting portion 26 for scribing. Pins 34 are selectively insertable into holes 32 on specimen mounting portion 26. Pins 34 can be inserted into any of the array of holes 32 as desired to hold a specimen 35 in the desired position for scribing. Securing specimens 35 during the scribing process can also be accomplished by other mechanisms such as spring arm clips, for example.

[0013] Recessed portion 28 is positioned adjacent to specimen mounting portion 26. Recessed portion 28 has a thickness T_1 that is less than a thickness T_2 of specimen mounting portion 26 with a top surface 36 of recessed portion 28 extending, or recessed, below top surface 30 of specimen mounting portion 26. A face 38 extends between top surface 36 and top surface 30 is perpendicular to top surfaces 26, 30. A thickness T_3 of positioner mounting portion 24 is greater than thickness T_1 of recessed portion 28. Positioner mounting portion 24 is sized to accommodate mounting of positioner 16. Positioner 16 can be secured to positioner mounting portion 24 with mechanical fasteners, such as bolts, or other suitable fasteners. A bottom surface 40 of platform 18 is generally planar and suitable for positioning on a work surface such as a microscope stage or table. Platform 18 can be aluminum, stainless steel, or other suitable material.

[0014] Scribe tool 10 can be used in dry scribing of glass wafers or substrates including silicon, GaAs, InP, and glass, for example. The versatility of pins 34 placement in the array of holes 32 on specimen mounting portion 26 accommodates specimens 35 of various size and shapes including any regular or irregular shape. Target 37 centered or un-centered along the x-axis on

specimen mounting portion 26. Positioner 16 can adjust and position scribe tip 12 to align relative to the position of target 37.

[0015] Positioner 16 facilitates manual adjusting of linear x, y, z axial movements of scribe tip 12. Positioner 16 includes adjusters 42_x , 42_y , 42_z for independent adjustment along each respective axes x, y, z. Adjusters 42_x , 42_y , 42_z are manual adjusters, suitable for a user to grasp and manually adjust, such as knobs that can be rotated, to facilitate movement of arm 14 and scribe tip 12 attached to distal end 20 of arm 14.

[0016] Proximal end 22 of arm 14 is secured to positioner 16 by clamping, welding, etc. at coupler 44. In one example, arm 14 is removably secured to positioner 16. Additionally, vertical adjustment of arm 14 outside of the range provided by adjuster 42_z can be desirable prior to securing arm 14 to positioner 16 and positioning scribe tip 12 adjacent a semiconductor wafer.

[0017] Arm 14 rigidly extends between proximal end 22 and distal end 20. Arm 14 may be a rigid material such as stainless steel, for example. Arm 14 includes an angled section 46 between distal and proximal ends 20, 22. Arm 14 extends downward from proximal end 22 at coupler 44 toward platform 18 to angled section 46. Angled section 46 is curved or bent to position distal end 20 near specimen mounting portion 26. In one suitable example, angled section 46 is bent or curved at 90° . Arm 14 extends from angled section 46 to distal end 20 generally parallel to platform 18. Distal end 20 is offset from proximal end 22 along y and z axes.

[0018] Figure 3 illustrates scribing tool 10 useful in an example scribing system 100. Scribing system 100 can be useful for scribing semiconductor wafers or other materials. Scribing system 100 includes a microscope 110, and a monitoring system 120. Scribing tool 10 is positioned under microscope 110 with specimen mounting portion 26 within a viewing range of an objective lens 112. Microscope 110 can be a high power or low power microscope. Microscope 110 can be a low powered stereo microscope, for example. Microscope 110 allows for change between overview and detailed inspection of the wafer. Monitoring system 120 can be a computing device having a monitor, for example.

[0019] Arm 14 extends from angled section 46 to distal end 20 a distance suitable to position distal end 20, and scribe tip 12 attached to distal end 20, under microscope 110. A clearance distance is provided between distal end 20 and lens 112 when scribe tool 10 is positioned under microscope 110. A working distance is established between specimen 35 and lens 110 for positioning and movement of scribe tip 10.

[0020] Figure 4 illustrates an exploded view of scribe tip 12 attached to distal end 20 and positioned adjacent specimen mounting portion 26. Distal end 20 can include a recessed area 48. Recessed area 48 is recessed into the circumference, or thickness, of arm 14 and includes a mounting surface 49 defined by recessed area 48 that scribe tip 12 is positioned against. Scribe tip 12 is at least partially formed of a hard material, such as a diamond, having a surface defining a vertical face or point suitable for forming a cut line in specimen 35 when brought in suitable contact with specimen 35. In one example, scribe tip 12 includes a block 50 and a diamond 52. Block 50 is coupled to arm 14 at recessed area 48.

[0021] As further illustrated in Figures 6A-6E, scribe tip 12 can be secured to distal end 20 with a fastener 54 extending through block 50. In one example, fastener 54 is a bolt or screw and is received in an opening 56a in distal end 20 and opening 56b in scribe tip 12. Opening 56b can be beveled, or counter-sunk to allow the bolt head to be received within opening 56b. Opening 56a can include threaded or smooth side walls. In another example, fastener 54 is a clip. In another example, an adhesive is used to secure scribe tip 12 to arm 14. Distal end 20 can include a beveled front surface 58 sloping back from scribe tip 12. Diamond 52 extends from block 50 and is oriented toward specimen mounting portion 26 and specimen 35 positioned on specimen mounting portion 26. In one example, diamond 52 is positioned along a bottom side of block 50. Block 50 can be a steel block or other suitably rigid material for securing diamond 52. Diamond 52 can be any shape suitable for scribing specimen 35. A vertical face of diamond 52 is oriented perpendicular to specimen mounting portion 26 such that the vertical face creates a single vertical scribe line and is not a scribe line that is skewed from vertical.

[0022] Figure 5 illustrates an example scribing process 200. At 202, a semiconductor wafer is positioned on a platform such that a lateral wafer face projects into a recess of the platform. At 204, a scribe tip is aligned with a target on the semiconductor wafer by adjusting the scribe tip position relative to the semiconductor wafer in an x-direction and a y-direction. At 206, a top of the scribe tip is aligned with a top surface of the semiconductor wafer. At 208, the scribe tip contacts the lateral wafer face. At 210, the scribe tip moves along the lateral wafer face from a top surface to a bottom surface of the wafer to form a scribe line in the lateral wafer face.

[0023] An example scribing process is illustrated in greater detail in Figures 6A-6E. In Figure 6A, adjusters 42_x , 42_y , 42_z of positioner 16 are manually manipulated to position scribe tip 12 adjacent to specimen 35. Specimen 35 extends slightly beyond specimen mounting portion 26 and a lateral face 39 projects over recessed portion 28. Pins 34 hold the wafer from moving in a y-axial direction. Microscope 110 can be focused on the wafer surface. Diamond 52 is aligned with a target 37 and the top surface of specimen 35. Alignment can be verified with microscope 110. Vertical or z-axial alignment of the top surface of specimen 35 and top of diamond 52 can be verified by both being in focus simultaneously, indicating that diamond 52 is at an aligned height along the z-axis with respect to specimen 35.

[0024] As illustrated in Figure 6B, diamond 52 is brought into contact with lateral face 39 of specimen 35 by a user manually manipulating adjuster 42_y to move diamond 52 in the y-axial direction. Figure 6C illustrates diamond 52 moving downward along lateral face 39 of specimen 35. Adjuster 42_z is manually manipulated to move diamond 52 in the z-axial direction. Scribing movement can be controlled by movement of adjuster 42_z . Figure 6D illustrates diamond 52 upon completion of scribing when diamond 52 is below the bottom of specimen 35. The overhang of specimen 35 into and above recessed portion 28 allows diamond 52 to be away from face 38 as diamond 52 completes the scribing. Diamond 52 can then be moved back away from specimen 35 in a y-axial direction by manipulating adjuster 42_y and then up from specimen 35 in a z-axial direction by manipulating adjuster 42_z . In this position, diamond 52 can

be cleaned before additional use. Figure 6E illustrates diamond 52 in this position.

[0025] Although specific examples have been illustrated and described herein, a variety of alternate and/or equivalent implementations may be substituted for the specific examples shown and described without departing from the scope of the present disclosure. This application is intended to cover any adaptations or variations of the specific examples discussed herein. Therefore, it is intended that this disclosure be limited only by the claims and the equivalents thereof.

CLAIMS

1. A scribing tool, comprising:
a scribe tip having a scribing surface;
an arm having a proximal end and a distal end, the scribe tip disposed at the distal end;
a positioner including a coupler to couple with the proximal end and adjusters to movably position the scribe tip; and
a platform including a positioner mounting portion, a specimen mounting portion, and a recessed area between the positioner mounting portion and the specimen mounting portion, the positioner disposed at the positioner mounting portion, and the distal end extending toward the specimen mounting portion.
2. The scribing tool of claim 1, wherein the specimen mounting portion includes an array of holes extending from a top surface to a distance within the specimen mounting portion.
3. The scribing tool of claim 2, comprising pins removably inserted into the holes.
4. The scribing tool of claim 1, wherein the scribe tip includes a mounting block to removably attach the scribe tip to the arm.
5. The scribing tool of claim 1, wherein the adjusters are manually manipulated to movably position the scribe tip.
6. The scribing tool of claim 1, wherein the adjusters movably position the scribe tip in three axial directions.
7. The scribing tool of claim 1, wherein the adjusters are manually adjustable knobs rotatable to reposition the scribe tip.

8. A scribing system for scribing a semiconductor wafer, comprising:
 - a scribe tip including a wafer contact area;
 - an arm including a distal end and a proximal end, the scribe tip disposed at the distal end;
 - a scribe positioner coupled to the proximal end of the arm, the scribe positioner including manual adjusters; and
 - a platform including a specimen mounting portion to support a wafer and maintain the wafer in a scribe position, and the platform including a positioner mounting portion, wherein the scribe positioner is coupled to the positioner mounting portion;
 - the scribe positioner to position the scribe tip in engagement with the wafer and move the scribe tip relative to the wafer while in engagement therewith and while the wafer is supported by and maintained against movement by the wafer support to form a scribe line in the wafer.
9. The scribing system of claim 8, comprising:
 - a magnification scope having a lens, wherein the at least a portion of the platform and the distal end of the arm are positionable under the lens.
10. The scribing system of claim 9, comprising:
 - a monitoring system to view a magnification view of the lens.
11. The scribing system of claim 8, wherein the scribe positioner includes adjusters to independently adjust the position of the scribe tip along any one of an x, y, or z axis.
12. The scribing system of claim 11, wherein the support structure includes a recessed portion extending between the specimen mounting portion and the positioner mounting portion.
13. A method of scribing a semiconductor wafer, comprising:

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positioning the semiconductor wafer on a platform such that a lateral wafer face projects into a recess of the platform;

aligning a scribe tip with a target on the wafer by adjusting a scribe tip position relative to the semiconductor wafer in an x-direction and a y-direction;

aligning a top of the scribe tip with a top surface of the semiconductor wafer;

contacting the scribe tip with the lateral wafer face; and

moving the scribe tip along the lateral wafer face from a top surface to a bottom surface of the semiconductor wafer to form a scribe line in the lateral wafer face.

14. The method of claim 13, comprising:

magnifying a view of the target to view the alignment of the target and the scribe tip.

15. The method of claim 13, comprising:

inserting pins into holes of the platform adjacent to a second wafer edge face opposite the first wafer edge face to secure the wafer at the desired position on the platform.

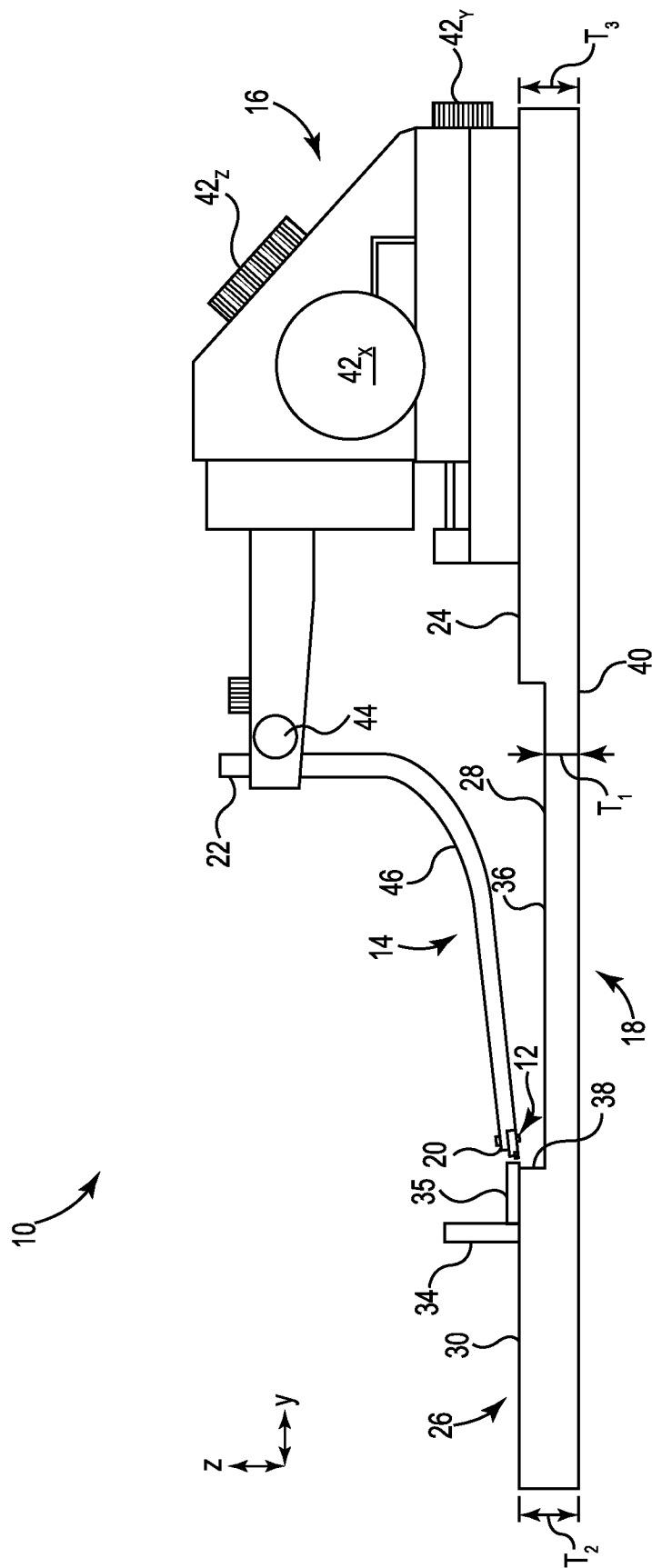


Fig. 1

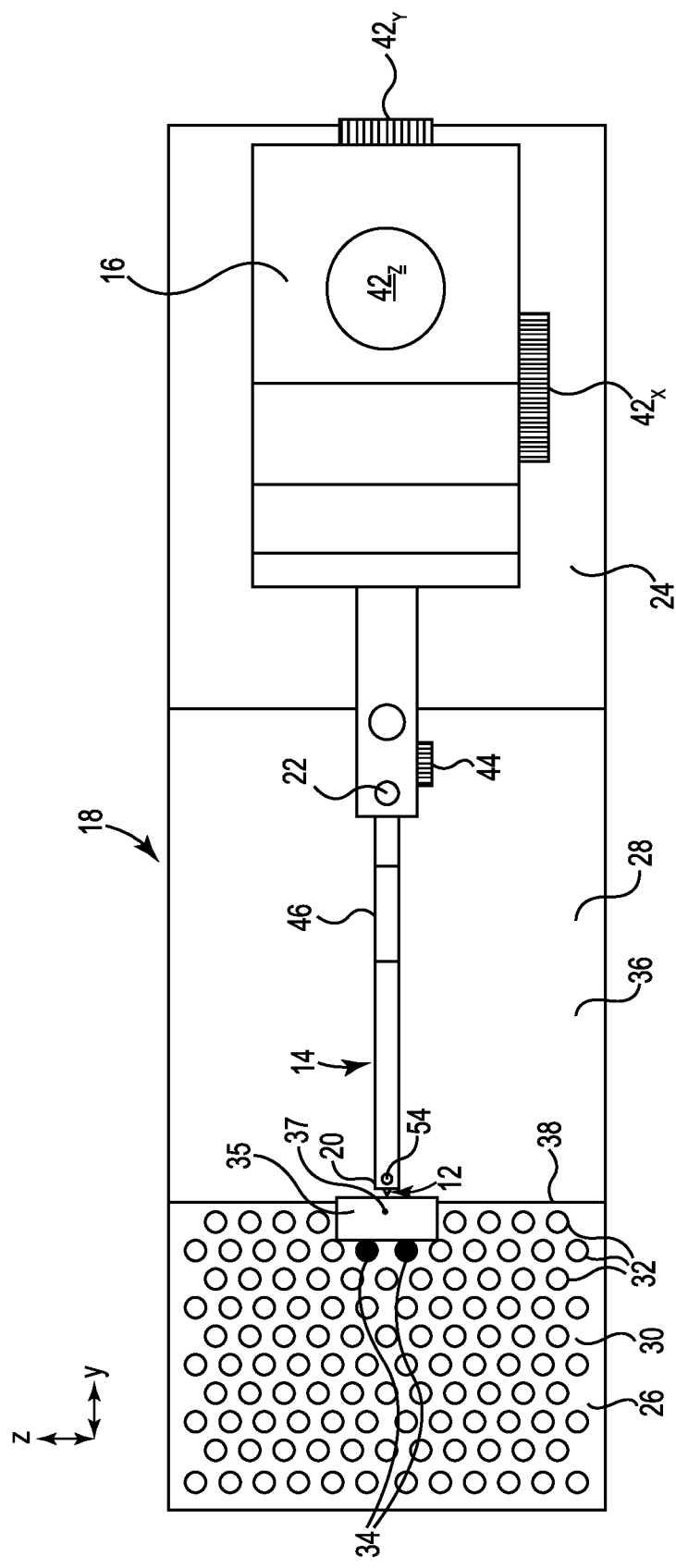


Fig. 2

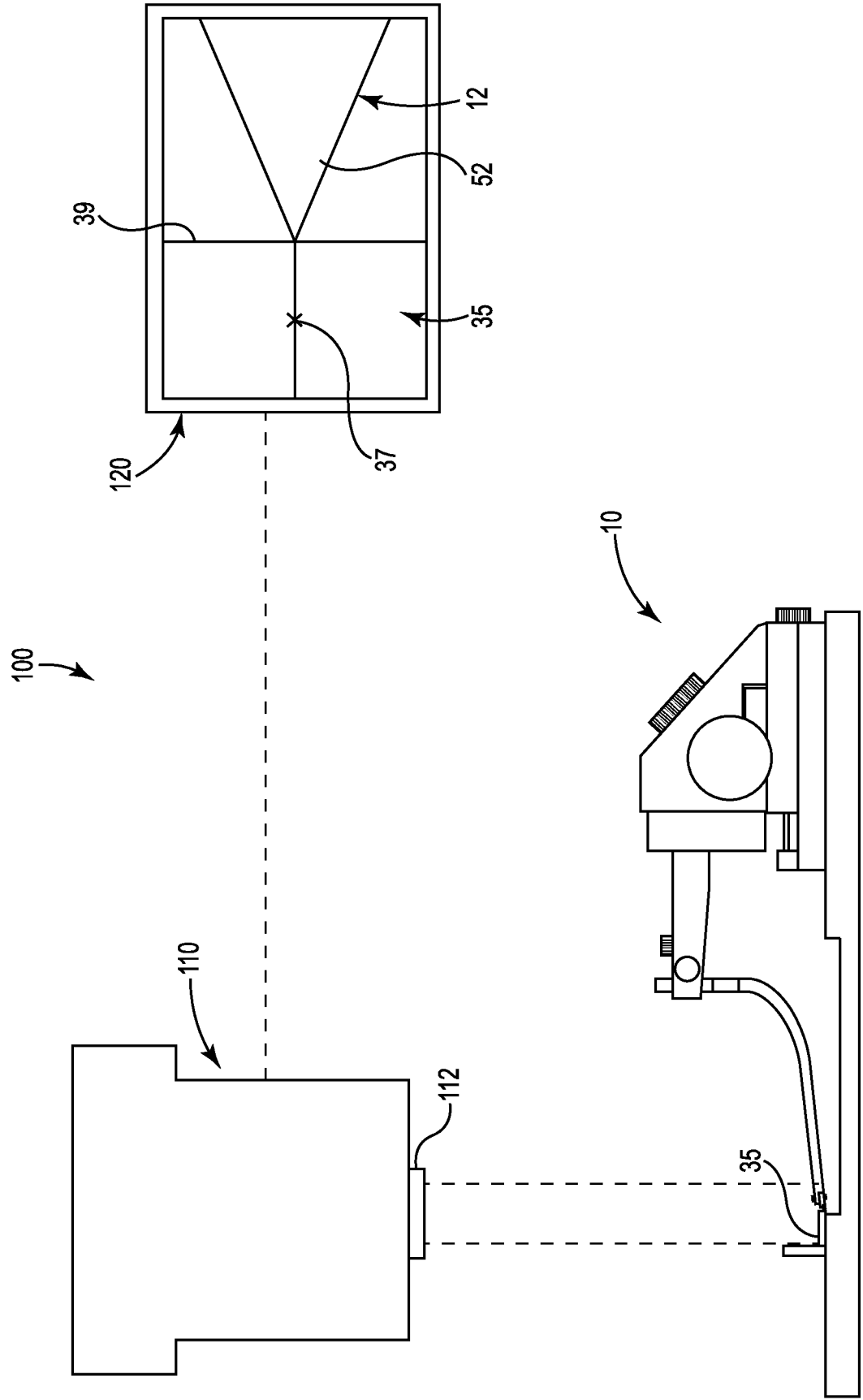


Fig. 3

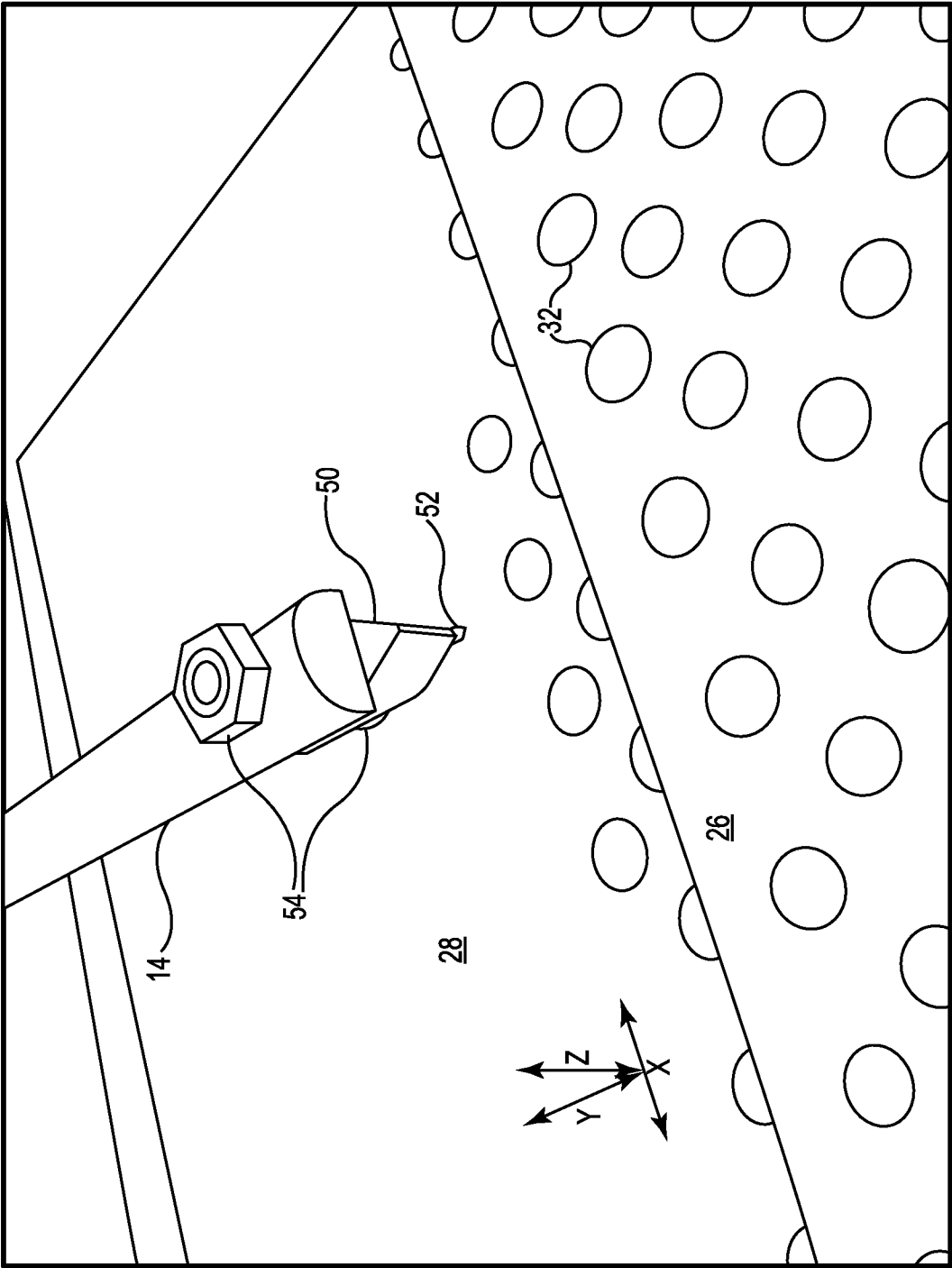
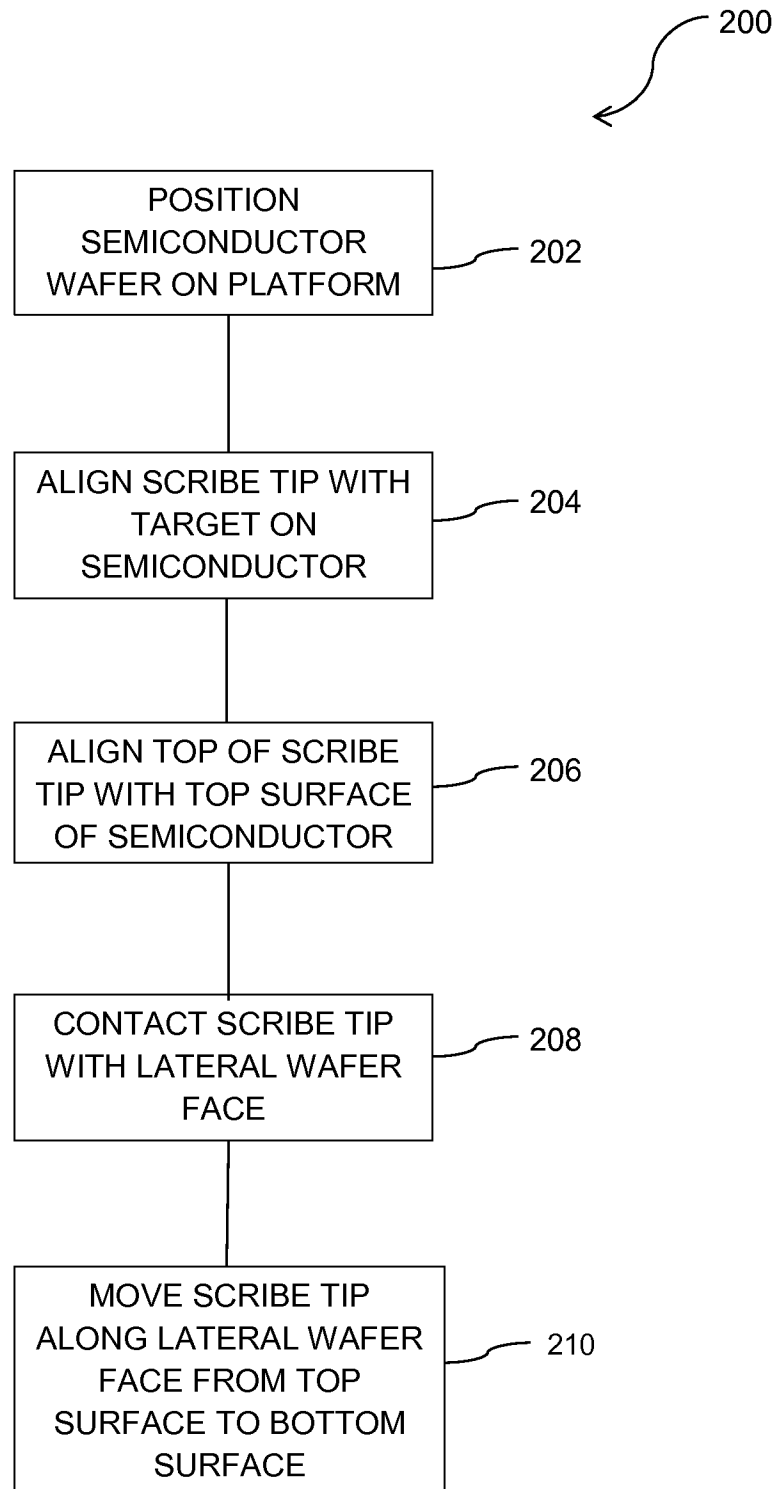


Fig. 4

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**Fig. 5**

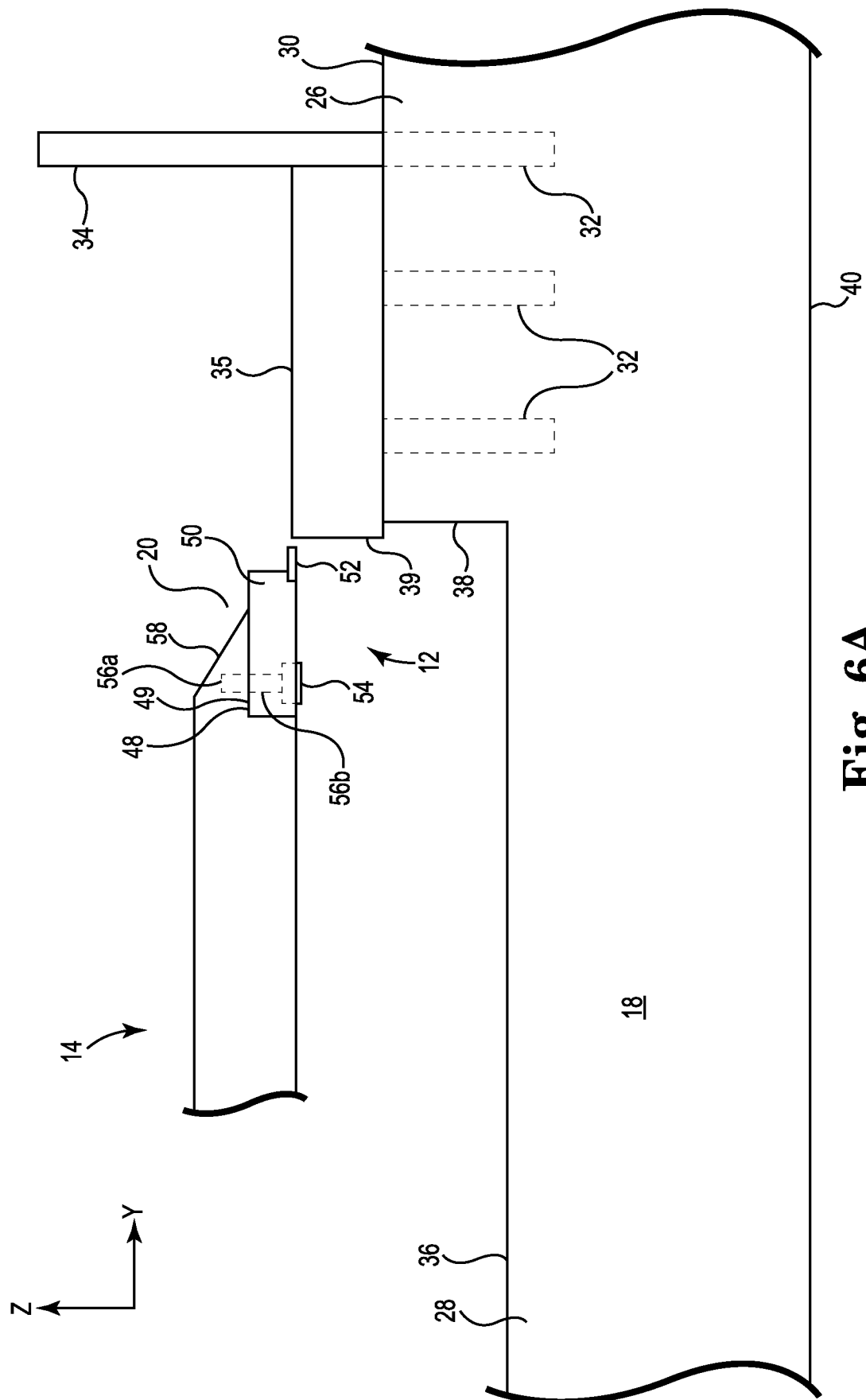


Fig. 6A

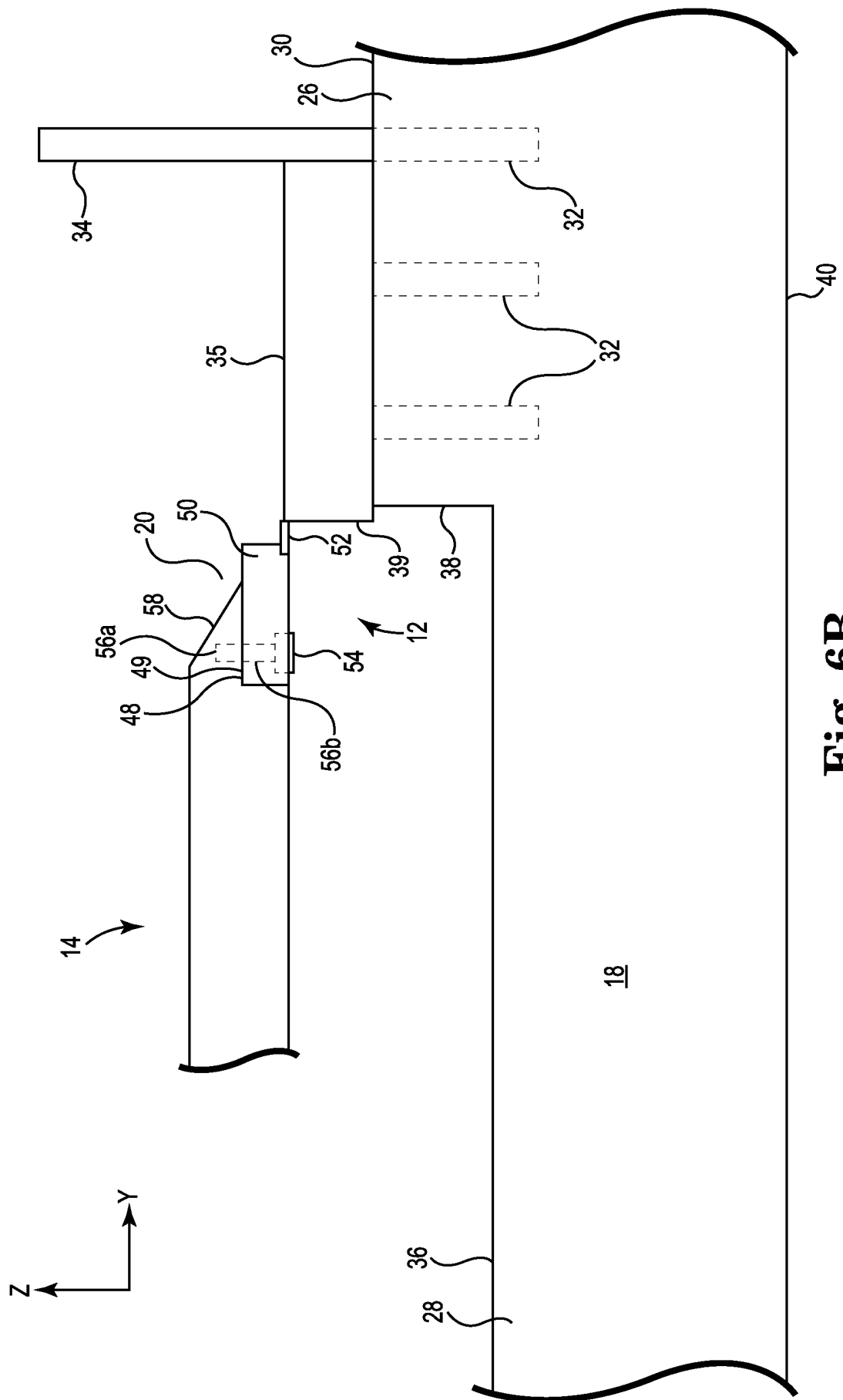


Fig. 6B

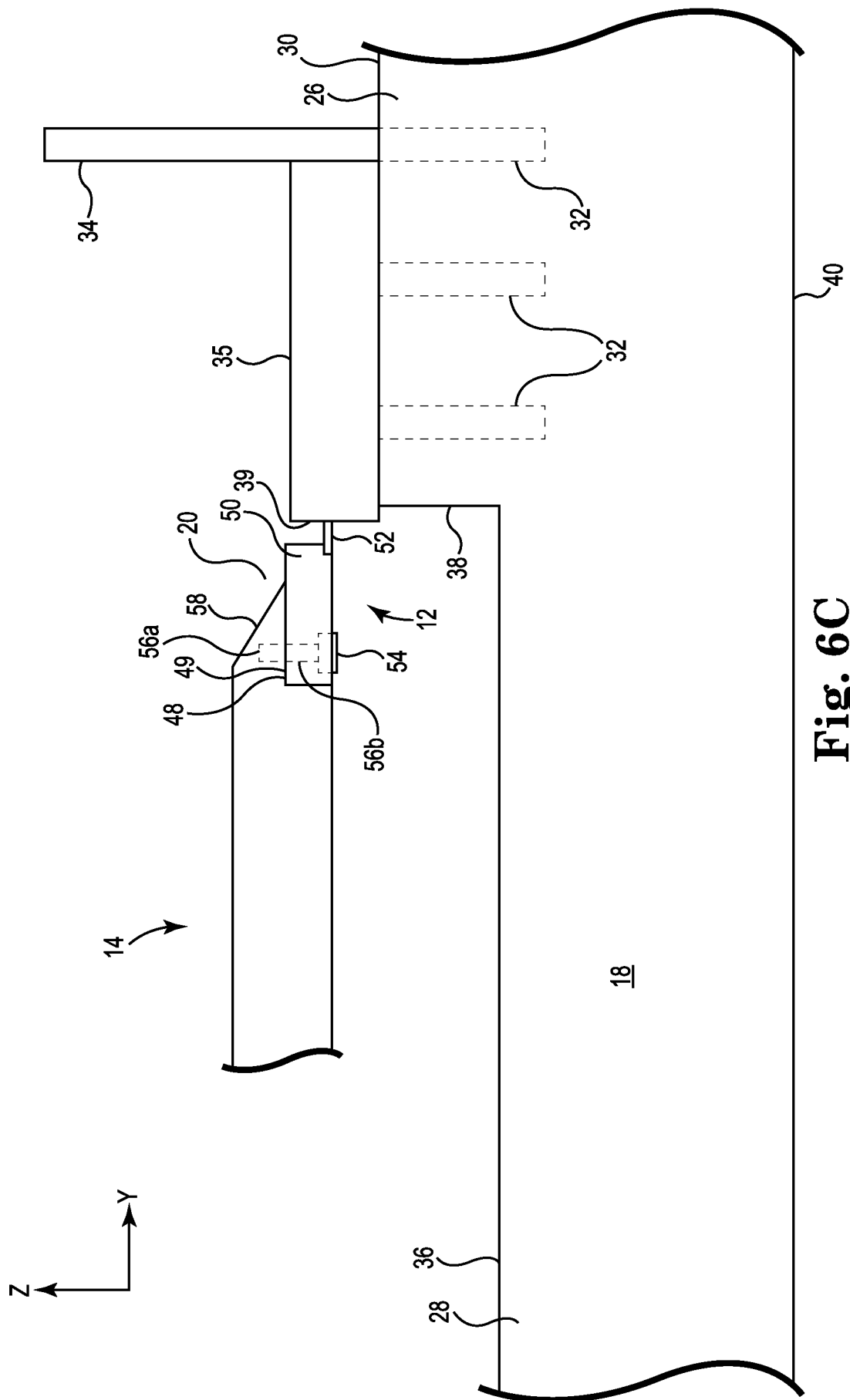


Fig. 6C

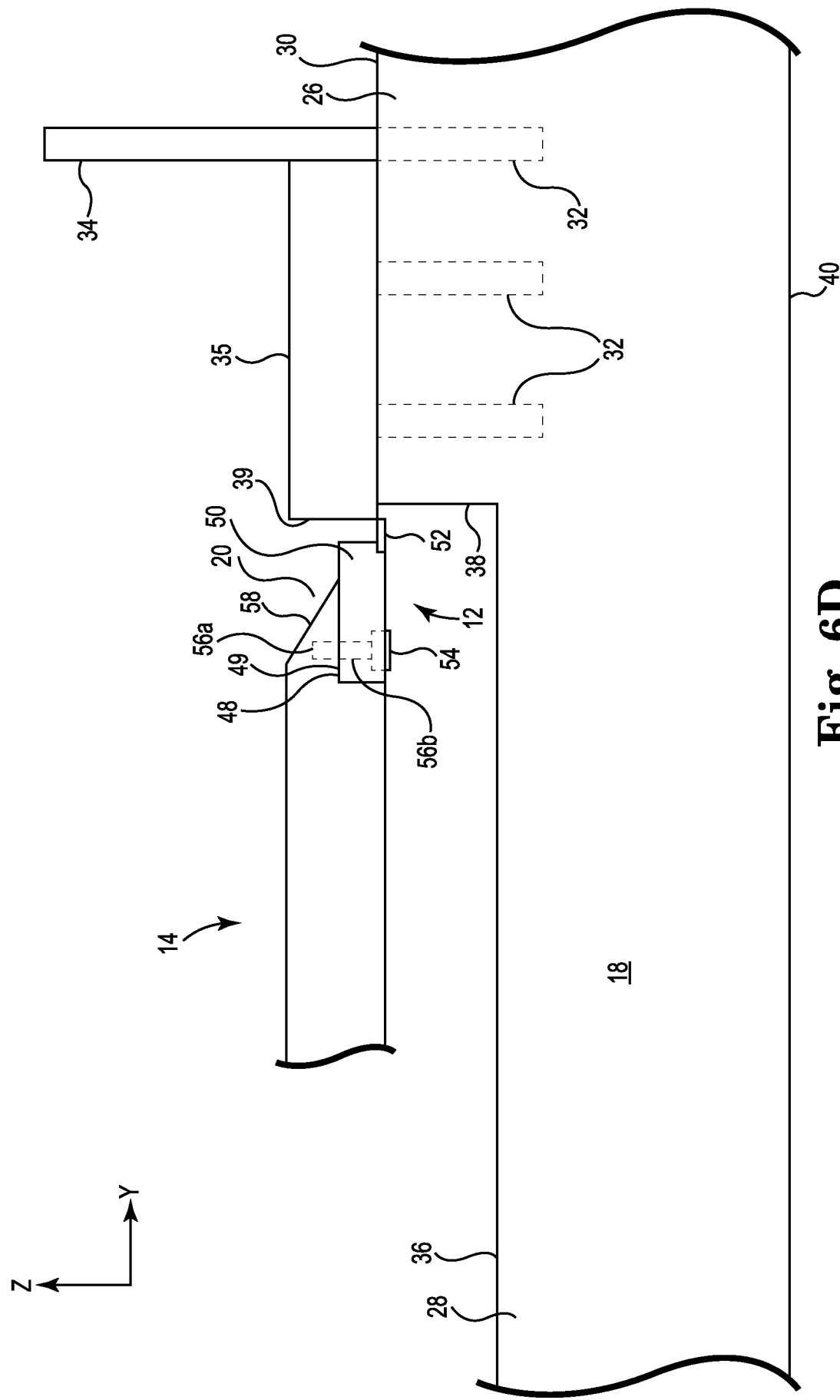
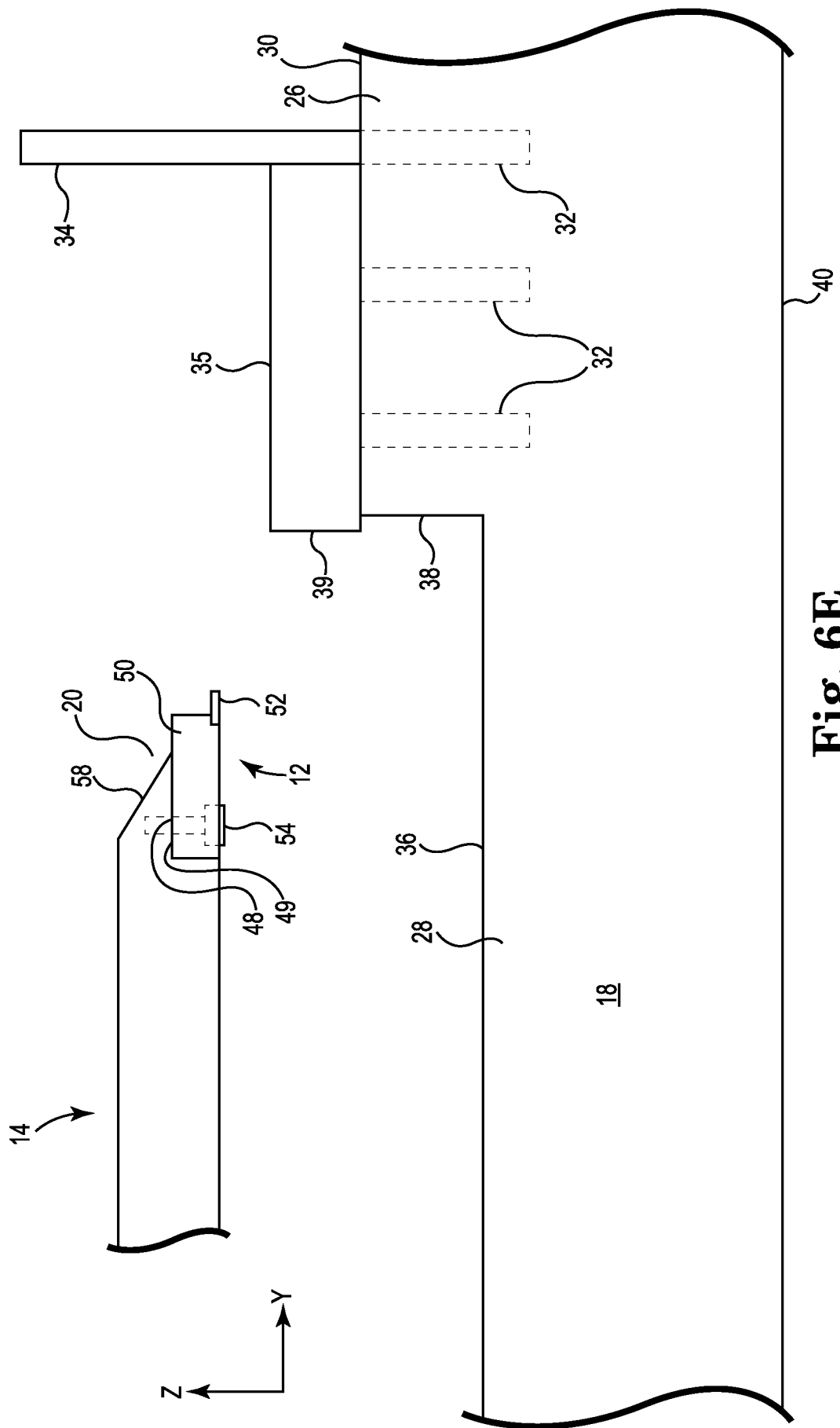


Fig. 6D



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/041324**A. CLASSIFICATION OF SUBJECT MATTER****H01L 21/76(2006.01)i, H01L 21/301(2006.01)i, H01L 21/78(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01L 21/76; H01L 21/268; G01N 1/28; C03B 33/02; B26D 5/02; H01L 21/301; B28D 5/00; H01L 21/00; H01L 21/78

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: scribing, arm, positioner, platform

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2009-0074919 A (UNIVERSITY-INDUSTRY COOPERATION GROUP OF KYUNG HEE UNIVERSITY) 08 July 2009 See abstract, paragraphs [0017]-[0046] and figures 1-2.	1-2, 4-12
A		3, 13-15
A	JP 2011-054709 A (DISCO ABRASIVE SYST. LTD.) 17 March 2011 See abstract, paragraphs [0012]-[0026] and figures 1-11.	1-15
A	JP 09-281016 A (DAINIPPON PRINTING CO., LTD.) 31 October 1997 See abstract, paragraphs [0010]-[0012] and figures 1-3.	1-15
A	US 2011-0067537 A1 (ROBERT RANNER et al.) 24 March 2011 See abstract, paragraphs [0035]-[0070] and figures 1-6.	1-15
A	US 7807479 B1 (PAUL C. LINDSEY, JR.) 05 October 2010 See abstract, column 3, line 10 - column 5, line 24 and figures 1-11.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan City, 35208,
Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

CHOI, Sang Won

Telephone No. +82-42-481-8291



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/041324

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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