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(54) Title: THERMALLY INSULATING ELECTRICAL CONTACT PROBE

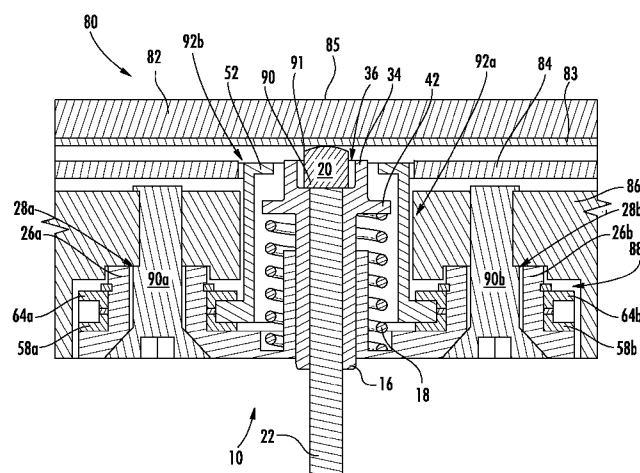


FIG. 2

(57) Abstract: A thermally insulating electrical contact probe including a mounting plate having a tubular pin guide defining a pin pass-through, a cover coupled to the mounting plate and having a neck portion enclosing the pin guide, and an insulating pin having a shank portion disposed within the pin pass-through and defining a conductor pass-through, a flange portion extending radially outwardly from the shank portion above a top of the pin guide, and a pocket portion extending from the flange portion and defining a pocket. The electrical contact probe may further include a spring disposed intermediate the flange portion and the mounting plate, the spring biasing the flange portion away from the mounting plate, an electrical contact pad disposed within the pocket, and an electrical conductor coupled to the electrical contact pad and extending through the conductor pass-through.



THERMALLY INSULATING ELECTRICAL CONTACT PROBE

Field of the Disclosure

[0001] Embodiments of the present disclosure relate to the field of electrical connection devices, and more particularly to a thermally insulating electrical contact probe.

Background of the Disclosure

[0002] Ion implantation is a technique for introducing conductivity-altering impurities into a substrate such as a wafer or other workpiece. A desired impurity material is ionized in an ion source of an ion beam implanter, the ions are accelerated to form an ion beam of prescribed energy, and the ion beam is directed at the surface of the substrate. The energetic ions in the ion beam penetrate into the bulk of the substrate material and are embedded into the crystalline lattice of the material to form a region of desired conductivity.

[0003] In some ion implant processes, a desired doping profile is achieved by implanting ions into a target substrate at high temperatures. Heating a substrate can be achieved by supporting the substrate on a heated platen during an ion implant process. A conventional heated platen may be connected to an electrical power source via a plurality of electrical contact probes. Additional electrical contact probes may be connected to the heated the platen for enabling electrostatic clamping of a substrate.

[0004] During operation, the various electrical contact probes connected to a heated platen may absorb heat from the heated platen and may reduce the temperature of the heated platen in localized areas adjacent to the electrical contact probes. As will be appreciated, any temperature variations in the material of the heated platen may affect the uniformity of heat transferred to a target substrate supported and heated by the heated platen, potentially having an adverse effect on an ion implant process. In some instances, temperature variations in a heated platen can cause the heated platen to warp, bow, or even crack.

[0005] In view of the foregoing, there is a need to mitigate heat losses via electrical connections in heated platens in order to achieve uniform platen temperatures.

Summary

[0006] This Summary is provided to introduce a selection of concepts in a simplified form. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended as an aid in determining the scope of the claimed subject matter.

[0007] An exemplary embodiment of a thermally insulating electrical contact probe for providing an electrical connection to a heated platen in accordance with the present disclosure may include a mounting plate having a tubular pin guide defining a pin pass-through, a cover coupled to the mounting plate and having a neck portion enclosing the pin guide, and an insulating pin having a shank portion disposed within the pin pass-through and defining a conductor pass-through, a flange portion

extending radially outwardly from the shank portion above a top of the pin guide, and a pocket portion extending from the flange portion and defining a pocket. The electrical contact probe may further include a spring disposed intermediate the flange portion and the mounting plate, the spring biasing the flange portion away from the mounting plate, an electrical contact pad disposed within the pocket, and an electrical conductor coupled to the electrical contact pad and extending through the conductor pass-through.

[0008] Another exemplary embodiment of a thermally insulating electrical contact probe for providing an electrical connection to a heated platen in accordance with the present disclosure may include a mounting plate having a tubular pin guide defining a pin pass-through, a cover coupled to the mounting plate and having a neck portion enclosing the pin guide, a mounting boss extending from the mounting plate and through a through-hole in the cover, a first insulating washer disposed on a top surface of the mounting plate and having a flange extending into a radial gap intermediate the mounting boss and the cover, a second insulating washer disposed on a top surface of the cover and having a flange extending into the radial gap intermediate the mounting boss and the cover, and an insulating pin having a shank portion disposed within the pin pass-through and defining a conductor pass-through, a flange portion extending radially outwardly from the shank portion above a top of the pin guide, and a pocket portion extending from the flange portion and defining a pocket. The electrical contact probe may further include a coil spring surrounding the pin guide and disposed intermediate the flange portion and the mounting plate, the spring biasing the flange portion away from the mounting plate, an electrical contact

pad disposed within the pocket, and an electrical conductor coupled to the electrical contact pad and extending through the conductor pass-through.

[0009] An exemplary embodiment of a heated platen assembly in accordance with the present disclosure may include a heated platen, a base coupled to the heated platen, a heat shield disposed intermediate, and coupled to, the heated platen and the base, an electrical contact probe coupled to the base and extending through the base and the heat shield, the electrical contact probe including a mounting plate having a tubular pin guide defining a pin pass-through, a cover coupled to the mounting plate and having a neck portion enclosing the pin guide, and an insulating pin having a shank portion disposed within the pin pass-through and defining a conductor pass-through, a flange portion extending radially outwardly from the shank portion above a top of the pin guide, and a pocket portion extending from the flange portion and defining a pocket. The heated platen assembly may further include an electrical contact pad disposed within the pocket, an electrical conductor coupled to the electrical contact pad and extending through the conductor pass-through, and a spring disposed intermediate the flange portion and the mounting plate, the spring biasing the flange portion away from the mounting plate and holding the electrical contact pad in engagement with a metallization layer on a backside of the heated platen.

Brief Description of the Drawings

[0010] By way of example, various embodiments of the disclosed apparatus will now be described, with reference to the accompanying drawings, wherein:

[0011] **FIG. 1a** is perspective view illustrating an exemplary embodiment of a thermally insulating electrical contact probe in accordance with the present disclosure;

[0012] **FIG. 1b** is cross-sectional view illustrating the thermally insulating electrical contact probe shown in **FIG. 1a** taken along plane *A-A*;

[0013] **FIG. 2** is cross-sectional view illustrating an exemplary embodiment of a heated platen assembly in accordance with the present disclosure including the thermally insulating electrical contact probe shown in **FIGS. 1a** and **1b**.

[0014] **FIG. 3** is bottom perspective view illustrating an exemplary embodiment of a heated platen assembly in accordance with the present disclosure

Detailed Description

[0015] Referring to **FIGS. 1a** and **1b**, an exemplary embodiment of a thermally-insulating electrical contact probe 10 (hereinafter "the probe 10") in accordance with the present disclosure is shown. The probe 10 may be provided for establishing an electrical connection between an electrical power source and a heated platen of an ion implanter, such as for heating the platen or for facilitating electrostatic clamping of a substrate disposed on the heated platen. During operation, the probe 10 may be operable to minimize an amount of heat absorbed from the heated platen to mitigate temperature variations across the heated platen. As will be appreciated, the probe 10 may be implemented in a heated platen used to support a substrate during processing thereof. For example, the heated platen may be used to support a substrate during an ion implant process, a plasma deposition process, an etching process, a chemical-mechanical planarization process, or generally any

process where a semiconductor substrate is to be supported on a heated platen. As such, an exemplary heated platen assembly is described below. The embodiments of the present disclosure are not limited by the exemplary heated platen assembly described herein and may find application in any of a variety of other platen applications used in a variety of semiconductor manufacturing processes.

[0016] The probe 10 may generally include a mounting plate 12, a cover 14, an insulating pin 16, a coil spring 18 (**FIG. 1b**), an electrical contact pad 20, and an electrical conductor 22. For the sake of convenience and clarity, terms such as "top," "bottom," "upper," "lower," "vertical," "horizontal," "lateral," "longitudinal," "radial," "inner," and "outer" may be used herein to describe the relative placement and orientation of the components of the probe 10 with respect to the geometry and orientation of the probe 10 as it appears in **FIGS. 1a** and **1b**. Said terminology will include the words specifically mentioned, derivatives thereof, and words of similar import.

[0017] The mounting plate 12 of the probe 10 may include a generally planar base portion 24 having a pair of tubular mounting bosses 26a, 26b extending from a top surface thereof. The mounting bosses 26a, 26b may define respective fastener pass-throughs 28a, 28b extending through the mounting plate 12 for accepting corresponding mechanical fasteners as further described below. The base portion 26 may further have a tubular pin guide 30 (**FIG. 1b**) extending from a top surface thereof intermediate the mounting bosses 26a, 26b. The pin guide 30 may define a pin pass-through 32 extending through the mounting plate 12 for accepting the insulating pin 16 and the electrical conductor 22 as further described below. The

mounting plate 12 may be formed of a high-temperature capable, thermally and electrically insulating material, such as Zirconia, Alumina, various thermoplastics, etc.

[0018] Referring to **FIG. 1b**, the insulating pin 16 may be a generally tubular member having a pocket portion 34 defining a pocket 36, a shank portion 38 extending from a bottom of the pocket portion 34 and defining a conductor pass-through 40 extending from a bottom of the pocket 36, and a flange portion 42 extending radially-outwardly from a top of the shank portion 38. The conductor pass-through 40 may be coaxial with, and may have a smaller diameter than, the pocket 36. The insulating pin 16 may be formed of a high-temperature capable, thermally and electrically insulating material, such as Zirconia, Alumina, various thermoplastics, etc.

[0019] The spring 18 may be a coil spring formed of a high-temperature capable metal. The spring 18 may surround and may extend above the pin guide 30, and may be seated within an annular trench 44 in the mounting plate 12 for preventing excessive horizontal movement of the spring 18 relative to the mounting plate 12. The flange portion 42 of the insulating pin 16 may be seated on top of the spring 18, and the shank portion 38 of the insulating pin 16 may extend down through the pin pass-through 32 of the pin guide 30 and may protrude from the bottom of the mounting plate 12. An outer diameter of the shank portion 38 may be smaller (e.g., at least 0.0015 inches smaller) than the diameter of the pin pass-through 32 to establish a free-running, locational clearance fit between the shank portion 38 and the pin guide 30. Thus, the shank portion 38 may freely move vertically within the pin pass-

through 32, and may also shift or tilt horizontally within the pin pass-through 32 as further described below.

[0020] The cover 14 of the probe 10 may be formed of a low-emissivity material, such as aluminum or nickel. The cover 14 may be disposed on top of the mounting plate 12 and may include a generally planar base portion 46 and a generally tubular neck portion 48 extending from a top surface of the base portion 46. The neck portion 48 may define an internal chamber 50 housing the pin guide 30, the insulating pin 16, and the spring 18. An annular flange 52 may extend radially inwardly from a top of the neck portion 48 and may define an aperture 54 having a diameter greater than the outer diameter of the pocket portion 34 of the insulating pin 16 and smaller than the outer diameter of the flange portion 42 of the insulating pin 16.

[0021] The base portion 46 of the cover 14 may include a pair of through-holes 56a, 56b for receiving the mounting bosses 26a, 26b of the mounting plate 12 therethrough, respectively. A first pair of lower insulating washers 58a, 58b may be seated on top of the base portion 24 of the mounting plate 12 surrounding the mounting bosses 26a, 26b, respectively, and may have respective flanged portions 60a, 60b extending into radial gaps 62a, 62b intermediate the mounting bosses 26a, 26b and the cover, respectively. Similarly, a second pair of upper insulating washers 64a, 64b may be seated on top of the base portion 46 of the cover 14 surrounding the mounting bosses 26a, 26b, respectively, and may have respective flanged portions 66a, 66b extending into the radial gaps 62a, 62b, respectively. A pair of retaining rings 70a, 70b may be removably disposed within respective grooves 72a, 72b in the outer surfaces of mounting bosses 26a, 26b above

the upper insulating washers 64a, 64b, thus securing the upper insulating washers 64a, 64b, the base portion 46 of the cover 14, and the lower insulating washers 58a, 58b against the base portion 24 of the mounting plate 12 in a vertically stacked arrangement. The lower insulating washers 58a, 58b and the upper insulating washers 64a, 64b may be formed of a low thermal conductivity material, such as Alumina, Zirconia, various thermoplastics, etc., for mitigating conductive heat transfer between the cover 14 and the mounting plate 12 as further described below.

[0022] The electrical contact pad 20 may be made from a thermally durable, electrically conducting material, such as nickel, and may be soldered or brazed to the electrical conductor 22. The electrical contact pad 20 may be disposed within the pocket 36 of the pocket portion 34 of the insulating pin 16, and the electrical conductor 22 may extend through the conductor pass-through 40 of the shank portion 38 of the insulating pin 16 and may be coupled to an electrical power source (not shown). The electrical contact pad 20 may have a diameter greater (e.g., at least 0.010 inches greater) than the diameter of the conductor pass-through 40 and smaller (e.g., at least 0.010 inches smaller) than the diameter of the pocket 36. Thus, the electrical contact pad 20 may rest on an annular shoulder 74 defined at the juncture of the pocket 36 and the conductor pass-through 40, with the shoulder 74 acting as a lower travel stop for retaining the electrical contact pad 20 within the pocket 36.

[0023] **FIG. 2** is a cross-sectional view illustrating an embodiment of the probe 10 installed in an exemplary heated platen assembly 80. The heated platen assembly 80 may include a heated platen 82, a metallization layer 83, a heat shield 84,

and a base 86 coupled together in a vertically-spaced, stacked relationship, in any of a variety of known manners.

[0024] The metallization layer 83 may include a plurality of metallic traces printed on or otherwise applied to the underside or backside of the heated platen 82 and covered with a layer of glass or other electrically insulating material. When an electric current is applied to the metallization layer 83, the metallization layer 83 may convert an amount of the electrical energy into heat. This heat may be conducted through the heated platen 82, thus heating a substrate disposed thereon.

[0025] The heat shield 84 may function to reduce an amount of heat transferred from the heated platen 82 to the relatively cold base 86. The heat shield 84 may thus be configured to reflect heat back toward the heated platen 82, away from the base 86.

[0026] The heated platen 82 may be formed of a thermally durable material, including a ceramic material such as alumina, aluminum nitride, boron nitride or a similar dielectric ceramic. The heat shield 84 may be formed of a thermally-reflective material, such as aluminum, stainless steel, titanium, or other low emissivity metal. The base 86 may be formed of any suitably rigid and durable material and may be part of, or may be coupled to, a scanning mechanism (not shown) capable of orienting the platen 82 at various angular and/or rotational positions during processing operations.

[0027] The probe 10 may be disposed within a complementary recess 88 in a bottom of the base 86 and may be removably fastened to the base 86 by a pair of mechanical fasteners 90a, 90b (e.g., screws or bolts) extending through the fastener

pass-throughs 28a, 28b in the mounting bosses 26a, 26b, respectively. The neck portion 48 of the cover 14 may extend upwardly through respective apertures 92a, 92b in the base 86 and the heat shield 84.

[0028] The spring 18 of the probe 10 may be held in compression between the mounting plate 12 and the flange portion 42 of the insulating pin 16, and may thus urge the insulating pin 16 upwardly, away from the mounting plate 12. The insulating pin 16, and particularly the shoulder 74 in the pocket portion 34 of the insulating pin 16, may in-turn urge the electrical contact pad 20 upwardly against the metallization layer 83. Thus, the spring 18 may allow the electrical contact pad 20 and the insulating pin 16 to be displaced vertically, such as may occur when a substrate is loaded onto, or removed from, the support surface 85 of the heated platen 82, while holding the electrical contact pad 20 in firm engagement with the metallization layer 83 to maintain a desired electrical connection between the electrical conductor 22 and the metallization layer 83. The flange 52 of the neck portion 48 of the cover 14 may act as an upper travel stop for limiting upward movement of the insulating pin 16, and the pin guide 30 of the mounting plate 12 may act as a lower travel stop for limiting downward movement of the insulating pin 16.

[0029] During operation of the platen assembly 80, electrical current may be applied to the metallization layer 83 via the electrical conductor 22 and the electrical contact pad 20. The electrical current may be provided for heating the heated platen 82 in the above-described manner, and/or for generating an electrostatic force for clamping a substrate to the support surface 85 of the heated platen 82. In either case, an amount of heat may be transferred from the heated platen 82 to the relatively

cold base 86 via conductive and/or radiative heat transfer (convective heat transfer is generally prevented since the platen assembly 80 may be located in a processing environment held at vacuum). Significant heat transfer from the heated platen 82 to the base 86 is generally undesirable since such heat transfer may create temperature variations in the heated platen 82. As will be appreciated, any temperature variations in the material of the heated platen 82 may affect the uniformity of heat transferred to a target substrate supported by the heated platen 82, adversely affecting an ion 82 may cause the heated platen 82 to warp, bow, or even crack.

[0030] The above-described structural features and configuration of the probe 10 may cooperate to mitigate heat transfer from the heated platen 82 to the relatively cold base 86, improving temperature uniformity in the heated platen 82. For example, the portion of the probe 10 in direct contact with the metallization layer 83 is merely the electrical contact pad 20, and the electrical contact pad 20 and the attached electrical conductor 22 are thermally insulated from the rest of the probe 10 by the insulating pin 16. This limited contact between the probe 10 and the metallization layer 83 may restrict conductive heat transfer from the heated platen 82 to the base 86 via the probe 10. Furthermore, since the diameter of the pocket 36 of the pocket portion 34 of the insulating pin 16 is larger than the diameter of the electrical contact pad 20, the bottom surface 90 of the electrical contact pad 20 is in contact with the insulating pin 16, with the sidewall 91 of the electrical contact pad 20 being radially spaced apart from the insulating pin 16. This limited contact between the electrical contact pad 20 and the insulating pin 16 may further restrict conductive heat transfer from the heated platen 82 to the base 86 via the probe 10. Still further, the above-described free-running fit between the shank portion 38 of the insulating

pin 16 and the pin guide 30 results in minimal physical contact between the shank portion 38 and the pin guide 30. This may further restrict conductive heat transfer from the heated platen 82 to the base 86 via the probe 10. Still further, the lower insulating washers 58a, 58b and the upper insulating washers 64a, 64b, being formed of a low thermal conductivity material and entirely separating the cover 14 from the mounting plate 12, may restrict conductive transfer from the cover 14 to the mounting plate 12. This may further restrict conductive heat transfer from the heated platen 82 to the base 86 via the probe 10. Still further, the cover 14, being formed of a low-emissivity material, may act as a radiation shield between the heated platen 82 and the underlying components of the probe 10. This may restrict radiative heat transfer from the heated platen 82 to probe 10, in-turn mitigating conductive heat transfer from the probe 10 to the base 86.

[0031] In addition to mitigating heat transfer from the heated platen 82 to the relatively cold base 86, the above-described structural features and configuration of the probe 10 may cooperate to allow thermal expansion and contraction of the heated platen 82 relative to the base 86 while maintaining a desired electrical connection with the heated platen 82. For example, since the diameter of the pocket 36 of the pocket portion 34 of the insulating pin 16 is larger than the diameter of the electrical contact pad 20, the electrical contact pad 20 may be allowed to move horizontally within the pocket 36 when the heated platen 82 expands and contracts while maintaining the physical connection between the electrical contact pad 20 and the heated platen 82. Furthermore, since the outer diameter of the shank portion 38 of the insulating pin 16 is smaller than the diameter of the pin pass-through 32 in the pin guide 30, the insulating pin 16 may be allowed to tilt or rock horizontally within the

pin guide 30 when the heated platen 82 expands and contracts while holding the electrical contact pad 20 in firm engagement with the heated platen 82.

[0032] In further embodiments, a plurality of electrical contact probes similar to the probe 10 described above may be implemented in a platen assembly in various configurations and arrangements to provide electrical connections for heating a platen, for enabling electrostatic clamping of substrates, and/or for facilitating various other features of a platen assembly requiring electrical power. For example, referring to the bottom perspective view of the platen assembly 94 shown in **FIG. 3**, a first plurality of electrical contact probes 10₁₋₆ similar to the probe 10 described above may be installed in a base 96 of the platen assembly 94 for enabling electrostatic clamping of substrates to a heated platen 98 of the platen assembly 94. A second plurality of electrical contact probes 10₇₋₁₀ similar to the probe 10 described above may be installed in the base 96 for heating the heated platen 98.

[0033] Thus, the above-described exemplary probe 10 may provide numerous advantages relative to conventional electrical contact probes commonly employed in platen assemblies for providing electrical connections to heated platens. For example, the probe 10 may greatly mitigate an amount of heat transferred from a heated platen to a relatively cold base of a heated platen assembly. This may improve temperature uniformity in a heated platen, thus improving the reliability of ion implant processes and reducing the likelihood of catastrophic platen failure. Additionally, the probe 10 may allow thermal expansion and contraction of a heated platen relative to a base of a heated platen assembly while maintaining a desired electrical connection to the heated platen. Still further, the probe 10 may operate effectively, and may confer all of the

above-described advantages, within a vacuum environment of a heated platen assembly.

[0034] The present disclosure is not to be limited in scope by the specific embodiments described herein. Indeed, other various embodiments of and modifications to the present disclosure, in addition to those described herein, will be apparent to those of ordinary skill in the art from the foregoing description and accompanying drawings. Thus, such other embodiments and modifications are intended to fall within the scope of the present disclosure. Furthermore, while the present disclosure has been described herein in the context of a particular implementation in a particular environment for a particular purpose, those of ordinary skill in the art will recognize its usefulness is not limited thereto. Embodiments of the present disclosure may be beneficially implemented in any number of environments for any number of purposes. Accordingly, the claims set forth below must be construed in view of the full breadth and spirit of the present disclosure as described herein.

Claims

1. A thermally insulating electrical contact probe comprising:
 - a mounting plate having a tubular pin guide defining a pin pass-through;
 - a cover coupled to the mounting plate and having a neck portion enclosing the pin guide;
 - an insulating pin having a shank portion disposed within the pin pass-through and defining a conductor pass-through, a flange portion extending radially outwardly from the shank portion above a top of the pin guide, and a pocket portion extending from the flange portion and defining a pocket;
 - a spring disposed intermediate the flange portion and the mounting plate, the spring biasing the flange portion away from the mounting plate;
 - an electrical contact pad disposed within the pocket; and
 - an electrical conductor coupled to the electrical contact pad and extending through the conductor pass-through.
2. The thermally insulating electrical contact probe of claim 1, further comprising at least one thermally insulating washer disposed intermediate, and separating, the cover and the mounting plate.
3. The thermally insulating electrical contact probe of claim 1, further comprising a mounting boss extending from the mounting plate and through a through-hole in the cover.

4. The thermally insulating electrical contact probe of claim 3, further comprising a thermally insulating washer disposed on a top surface of the mounting plate and having a flange extending into a radial gap intermediate the mounting boss and the cover.

5. The thermally insulating electrical contact probe of claim 3, further comprising a thermally insulating washer disposed on a top surface of the cover and having a flange extending into a radial gap intermediate the mounting boss and the cover.

6. The thermally insulating electrical contact probe of claim 1, wherein a diameter of the pocket is at least 0.010 inches greater than a diameter of the electrical contact pad to allow the electrical contact pad to move horizontally within the pocket.

7. The thermally insulating electrical contact probe of claim 1, wherein a diameter of the pin pass-through is at least 0.0015 inches greater than a diameter of the shank portion of the insulating pin to establish a free-running fit between the shank portion and the pin guide and to allow the shank portion to tilt within the pin pass-through.

8. The thermally insulating electrical contact probe of claim 1, wherein an annular shoulder is defined at a juncture of the pocket and the conductor pass-through, the shoulder providing a travel stop for limiting movement of the electrical contact pad.

9. A heated platen assembly comprising:

a heated platen;

a base coupled to the heated platen;

a heat shield disposed intermediate, and coupled to, the heated platen and the base;

an electrical contact probe coupled to the base and extending through the base and the heat shield, the electrical contact probe comprising:

a mounting plate having a tubular pin guide defining a pin pass-through;

a cover coupled to the mounting plate and having a neck portion enclosing the pin guide;

an insulating pin having a shank portion disposed within the pin pass-through and defining a conductor pass-through, a flange portion extending radially outwardly from the shank portion above a top of the pin guide, and a pocket portion extending from the flange portion and defining a pocket;

an electrical contact pad disposed within the pocket;

an electrical conductor coupled to the electrical contact pad and extending through the conductor pass-through; and

a spring disposed intermediate the flange portion and the mounting plate, the spring biasing the flange portion away from the mounting plate and holding the electrical contact pad in engagement with a metallization layer on a backside of the heated platen.

10. The thermally insulating electrical contact probe of claim 9, further comprising a mounting boss extending from the mounting plate and through a through-hole in the cover.

11. The thermally insulating electrical contact probe of claim 10, further comprising a thermally insulating washer disposed on a top surface of the mounting plate and having a flange extending into a radial gap intermediate the mounting boss and the cover.

12. The thermally insulating electrical contact probe of claim 10, further comprising a thermally insulating washer disposed on a top surface of the cover and having a flange extending into a radial gap intermediate the mounting boss and the cover.

13. The thermally insulating electrical contact probe of claim 9, wherein a diameter of the pocket is at least 0.010 inches greater than a diameter of the electrical contact pad to allow the electrical contact pad to move horizontally within the pocket.

14. The thermally insulating electrical contact probe of claim 9, wherein a diameter of the pin pass-through is at least 0.0015 inches greater than a diameter of the shank portion of the insulating pin to establish a free-running fit between the shank portion and the pin guide and to allow the shank portion to tilt within the pin pass-through.

15. The thermally insulating electrical contact probe of claim 9, wherein an annular shoulder is defined at a juncture of the pocket and the conductor pass-through, the shoulder providing a travel stop for limiting movement of the electrical contact pad.

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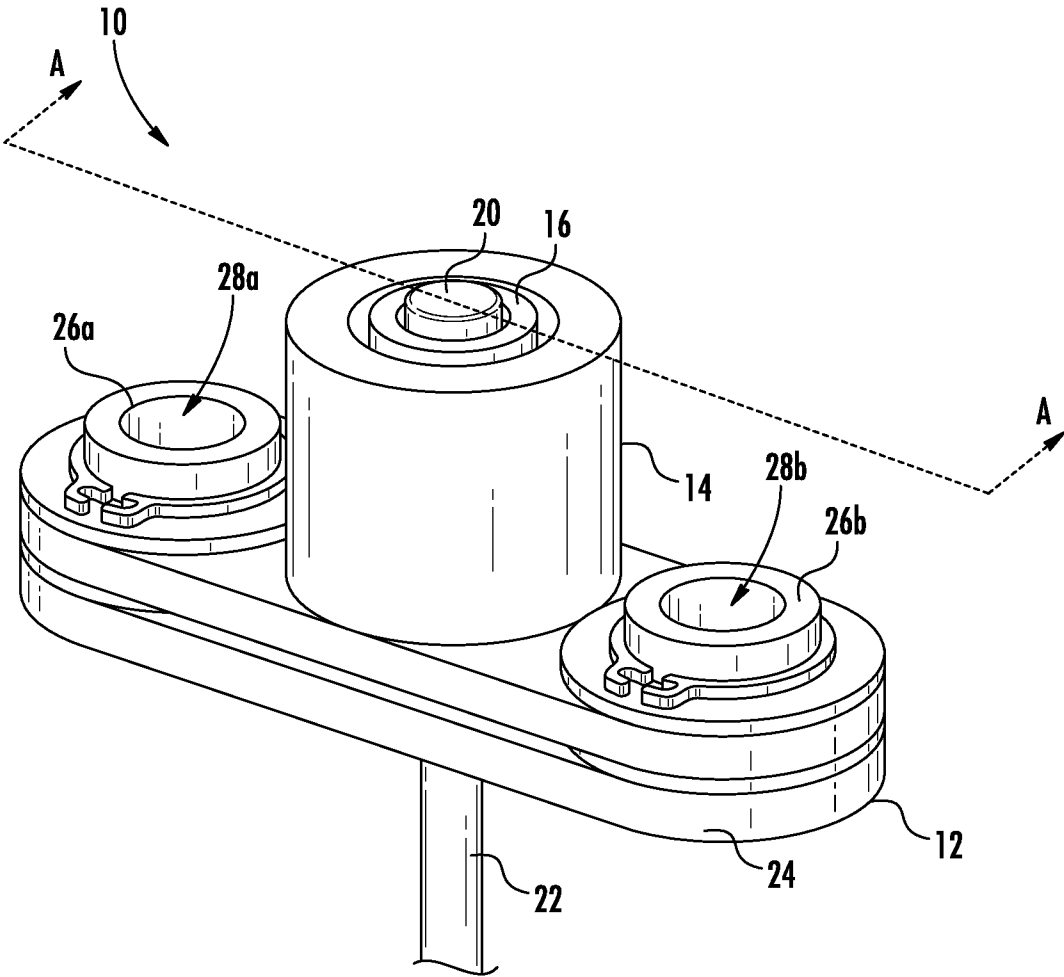


FIG. 1A

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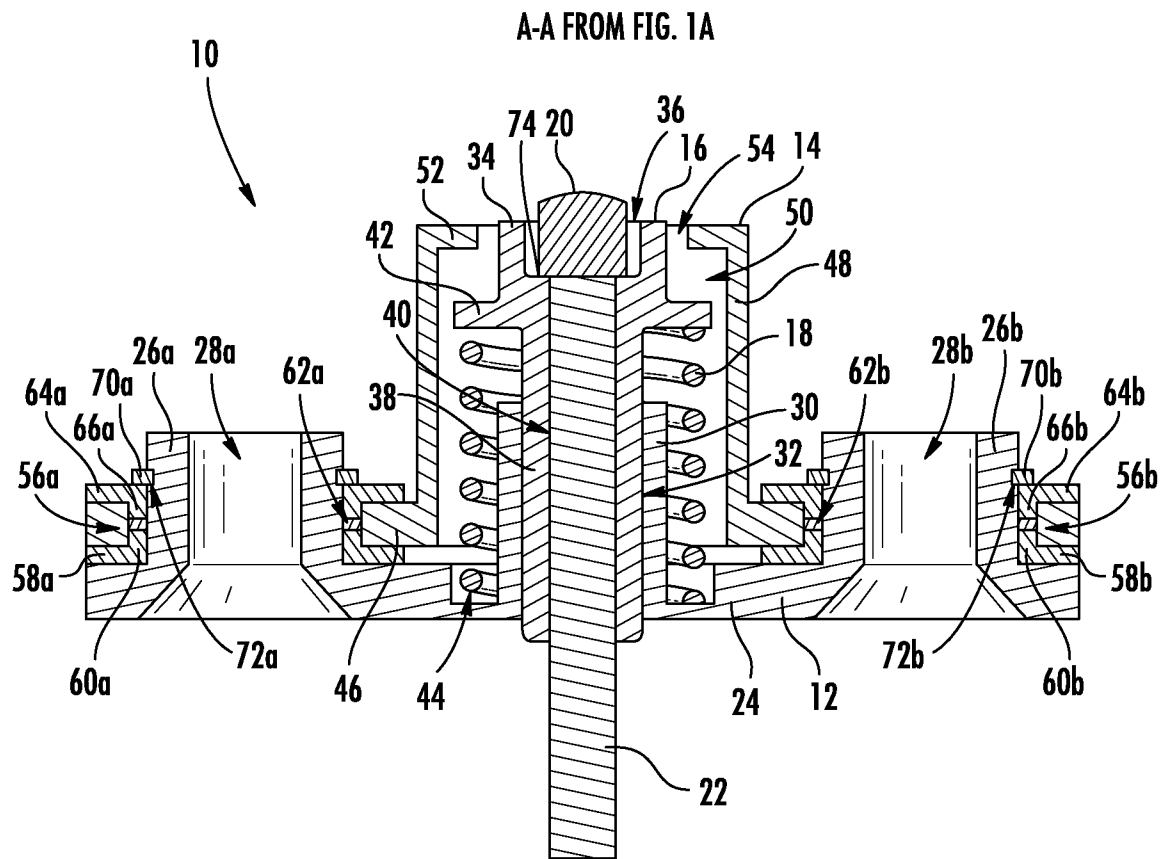


FIG. 1B

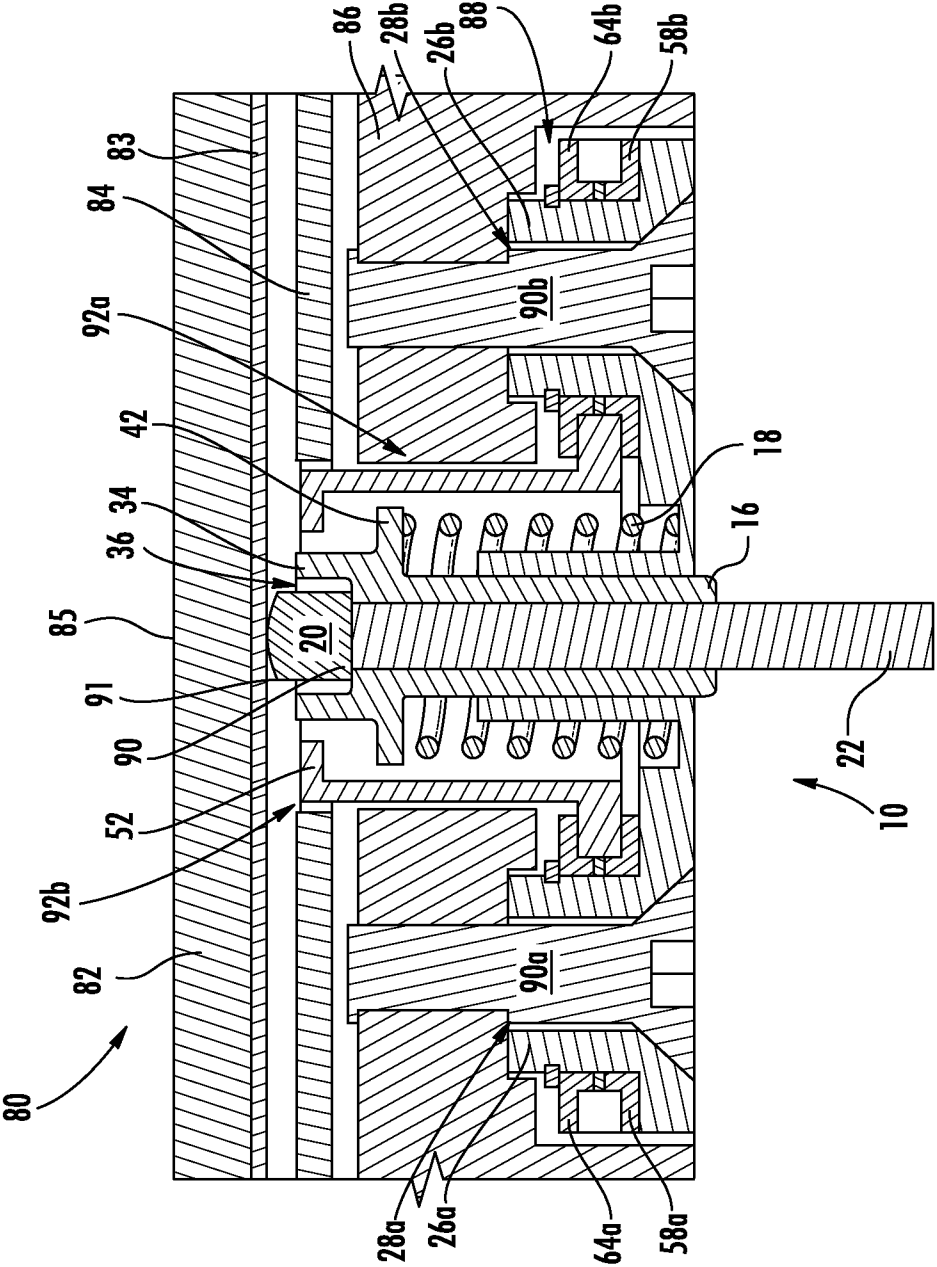
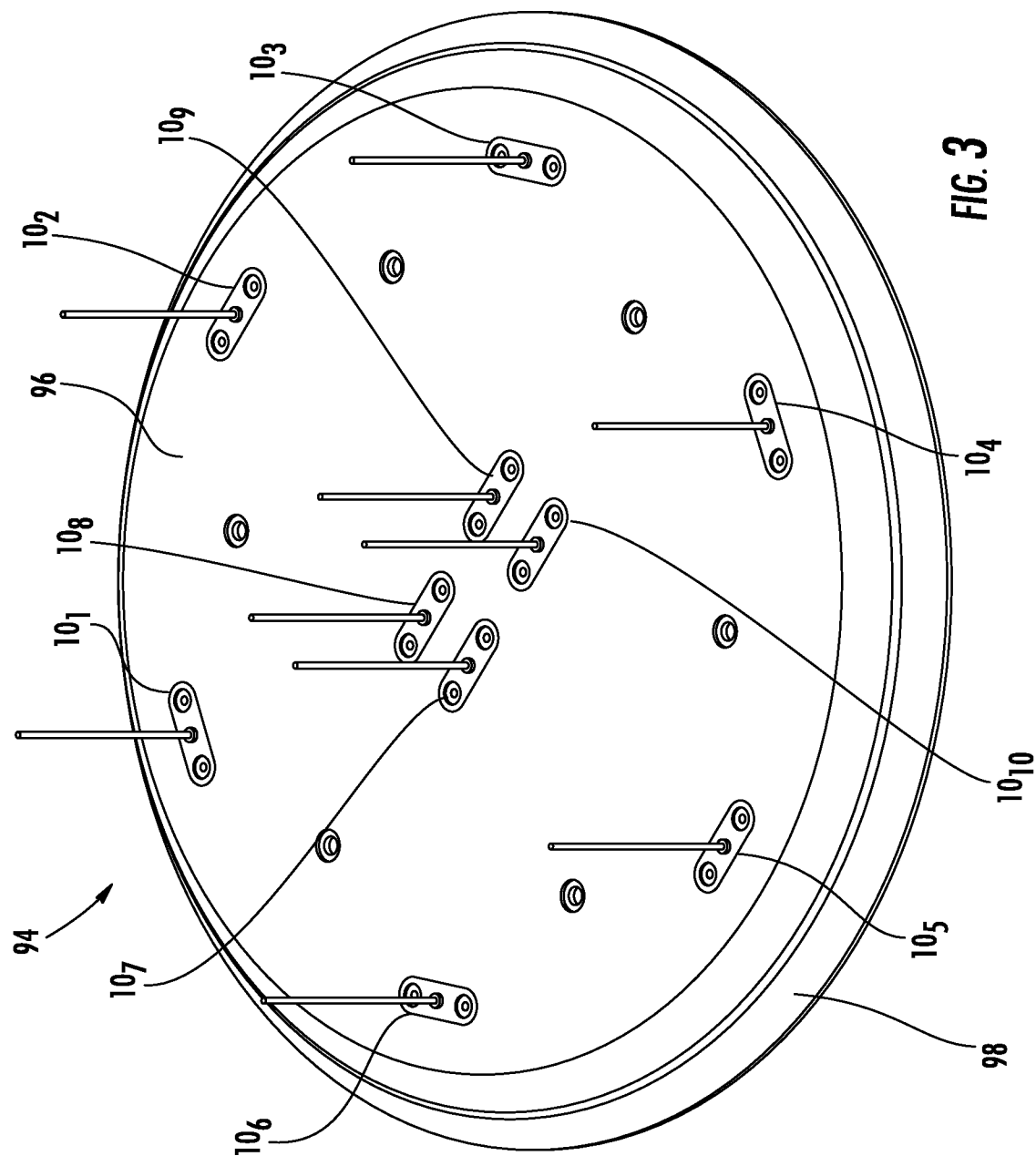


FIG. 2



A. CLASSIFICATION OF SUBJECT MATTER**H01L 21/265(2006.01)i, H01L 21/324(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 21/265; F16C 29/02; C23C 16/458; H01L 21/683; H01J 37/32; H01L 21/44; C23C 16/00; G01R 33/36; H01L 21/324

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: chamber, platen, pin, probe, thermal, uniform

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013-0101241 A1 (APPLIED MATERIALS, INC.) 25 April 2013 See abstract, paragraphs [0022]-[0038] and figures 1-2B.	1-15
A	WO 2006-078585 A2 (ASM AMERICA, INC. et al.) 27 July 2006 See abstract, paragraphs [0042]-[0051] and figure 1C.	1-15
A	WO 2014-143505 A1 (APPLIED MATERIALS, INC.) 18 September 2014 See abstract, paragraphs [0024]-[0029] and figure 2.	1-15
A	US 2014-0332161 A1 (LAM RESEARCH CORPORATION) 13 November 2014 See abstract, paragraphs [0038]-[0041] and figure 10.	1-15
A	US 2009-0295388 A1 (XIAO ZHANG et al.) 03 December 2009 See abstract, paragraph [0024] and figures 2a-2c.	1-15



Further documents are listed in the continuation of Box C.



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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/028085

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013-0101241 A1	25/04/2013	CN 103828035 A JP 2015-501537 A JP 5896387 B2 KR 10-1549854 B1 KR 10-2014-0076631 A TW 201319419 A TW I507617 B US 8911151 B2 WO 2013-058970 A1	28/05/2014 15/01/2015 30/03/2016 03/09/2015 20/06/2014 16/05/2013 11/11/2015 16/12/2014 25/04/2013
WO 2006-078585 A2	27/07/2006	CN 101495668 A EP 1866465 A2 JP 2008-527748 A JP 2008-533697 A JP 2012-089863 A JP 4934595 B2 JP 5722753 B2 KR 10-1332739 B1 KR 10-1463581 B1 KR 10-2007-0091332 A KR 10-2007-0100354 A KR 10-2013-0027575 A TW I412063 B US 2006-0156981 A1 US 2006-0266289 A1 US 2012-0266821 A1 US 8211230 B2 WO 2006-078585 A3 WO 2006-078666 A2 WO 2006-078666 A3	29/07/2009 19/12/2007 24/07/2008 21/08/2008 10/05/2012 16/05/2012 27/05/2015 25/11/2013 20/11/2014 10/09/2007 10/10/2007 15/03/2013 11/10/2013 20/07/2006 30/11/2006 25/10/2012 03/07/2012 16/04/2009 27/07/2006 12/10/2006
WO 2014-143505 A1	18/09/2014	TW 201448106 A US 2014-0251208 A1 US 9123765 B2	16/12/2014 11/09/2014 01/09/2015
US 2014-0332161 A1	13/11/2014	CN 101095212 A CN 101095212 B JP 2008-527694 A JP 4881319 B2 KR 10-1094122 B1 KR 10-2007-0121637 A KR 10-2009-0089449 A KR 10-2010-0034770 A SG 158164 A1 TW I403617 B US 2006-0144516 A1 US 2009-0078360 A1 US 2012-0018411 A1 US 2013-0072024 A1	26/12/2007 06/07/2011 24/07/2008 22/02/2012 15/12/2011 27/12/2007 21/08/2009 01/04/2010 29/01/2010 01/08/2013 06/07/2006 26/03/2009 26/01/2012 21/03/2013

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/028085

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009-0295388 A1	03/12/2009	US 8038796 B2	18/10/2011
		US 8051556 B2	08/11/2011
		US 8735298 B2	27/05/2014
		US 8821639 B2	02/09/2014
		WO 2006-073947 A2	13/07/2006
		WO 2006-073947 A3	05/04/2007
		US 7800369 B2	21/09/2010
		WO 2009-155072 A2	23/12/2009
		WO 2009-155072 A3	25/02/2010