US 20040173345A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2004/0173345 A1

Belady et al. (43) Pub. Date: Sep. 9, 2004

(54) THERMAL TRANSFER INTERFACE SYSTEM AND METHODS

(76) Inventors: **Christian L. Belady**, McKinney, TX (US); **Eric C. Peterson**, McKinney, TX (US)

Correspondence Address:
HEWLETT PACKARD COMPANY
P O BOX 272400, 3404 E. HARMONY ROAD
INTELLECTUAL PROPERTY ADMINISTRATION
FORT COLLINS, CO 80527-2400 (US)

(21) Appl. No.: 10/676,982

(22) Filed: Oct. 1, 2003

Related U.S. Application Data

(62) Division of application No. 10/074,642, filed on Feb. 12, 2002.

Publication Classification

(51) Int. Cl.[7] F28F 7/00

(52) U.S. Cl. 165/185

(57) ABSTRACT

The invention provides a thermal transfer interface for dissipating heat from an object to a thermal spreader and/or heat sink. The spreader forms a plurality of passageways. A spring element couples with the spreader. A plurality of thermally conductive pins moves along the passageways, extending outwardly via the spring element for conformal and thermal contact with the object. Thermal energy transfers from the object to the spreader through the collective area defining the interface between the pins and the spreader. The spring element is preferably thermally conductive; and thermal grease added to the interface may beneficially decrease thermal resistances due to microscopic unevenness at the contact between the object and the pins and/or spring element. An additional heat sink may couple to the spreader to dissipate additional thermal energy.

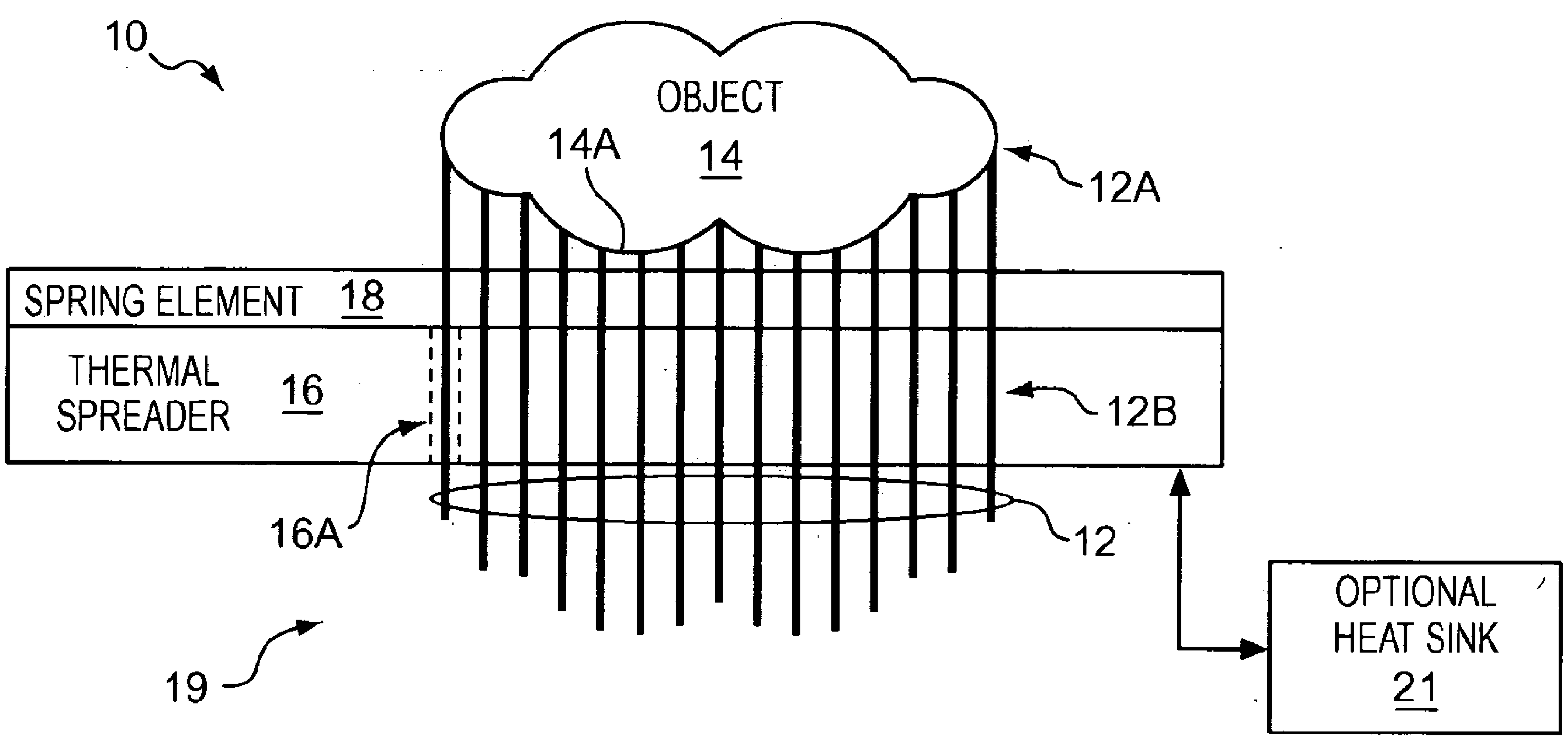


FIG. 1

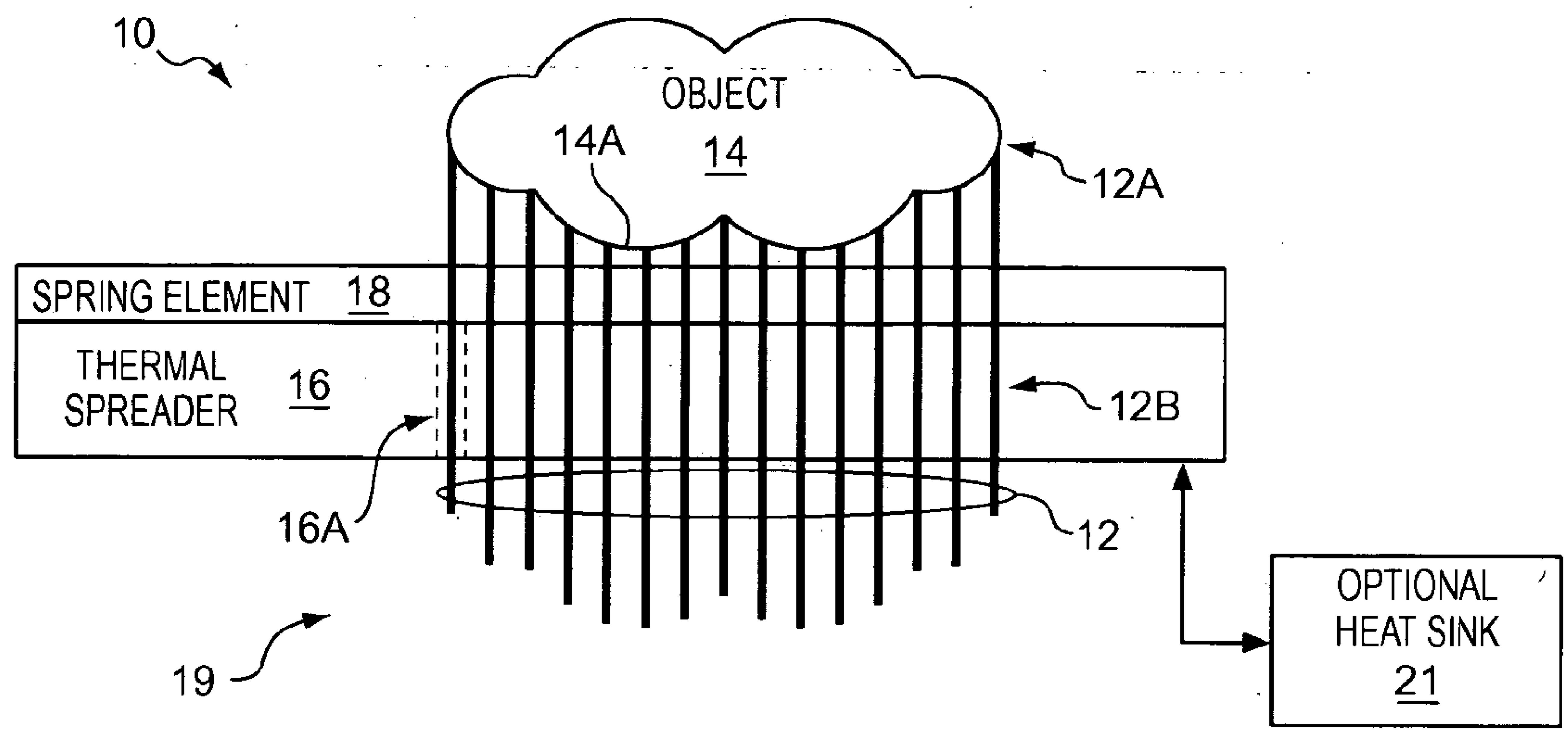

10
OBJECT
14
14A
12A
SPRING ELEMENT 18
THERMAL SPREADER 16
12B
16A
12
19
OPTIONAL HEAT SINK 21

FIG. 2

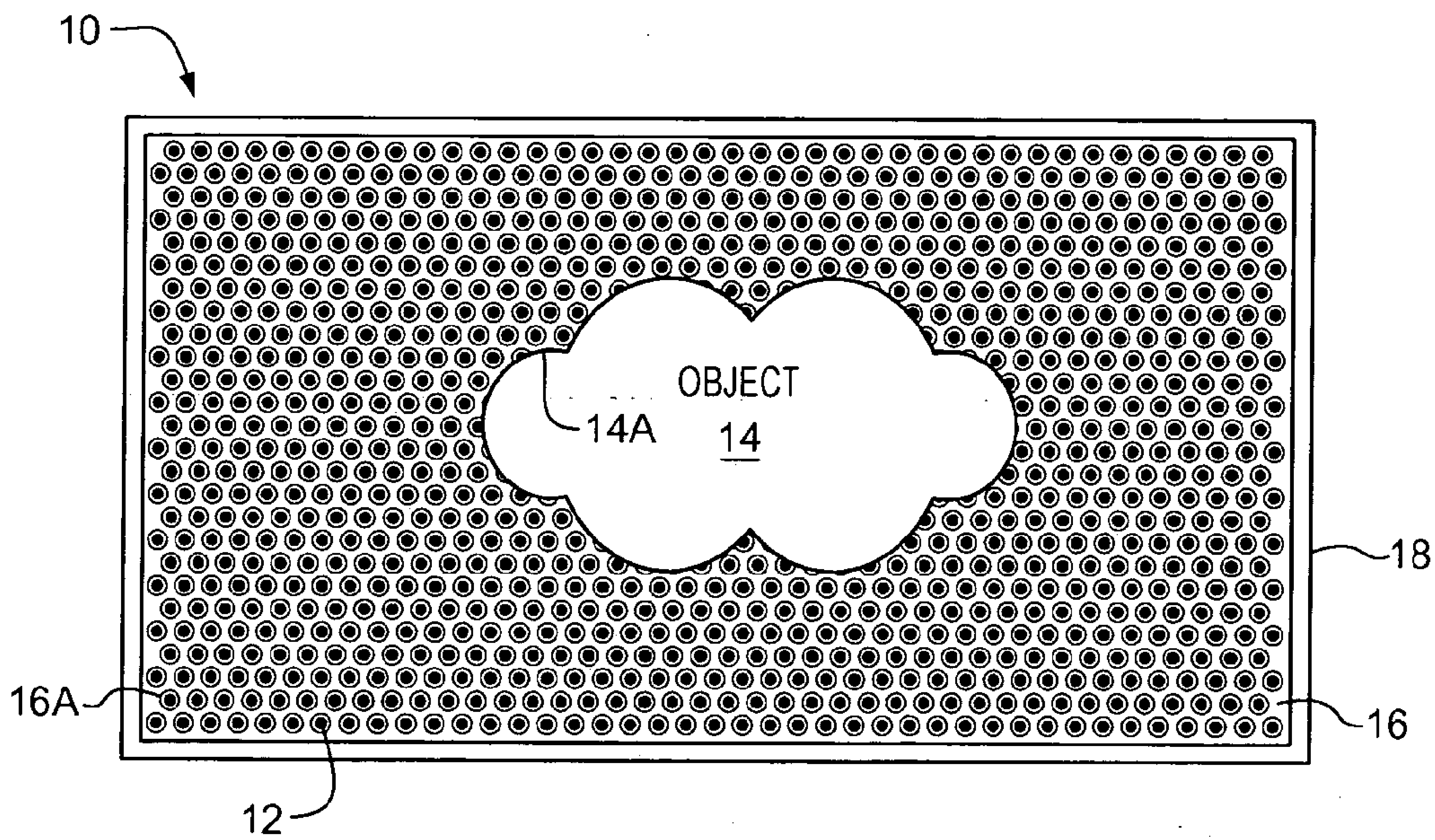

10
OBJECT
14
14A
18
16A
16
12

FIG. 3

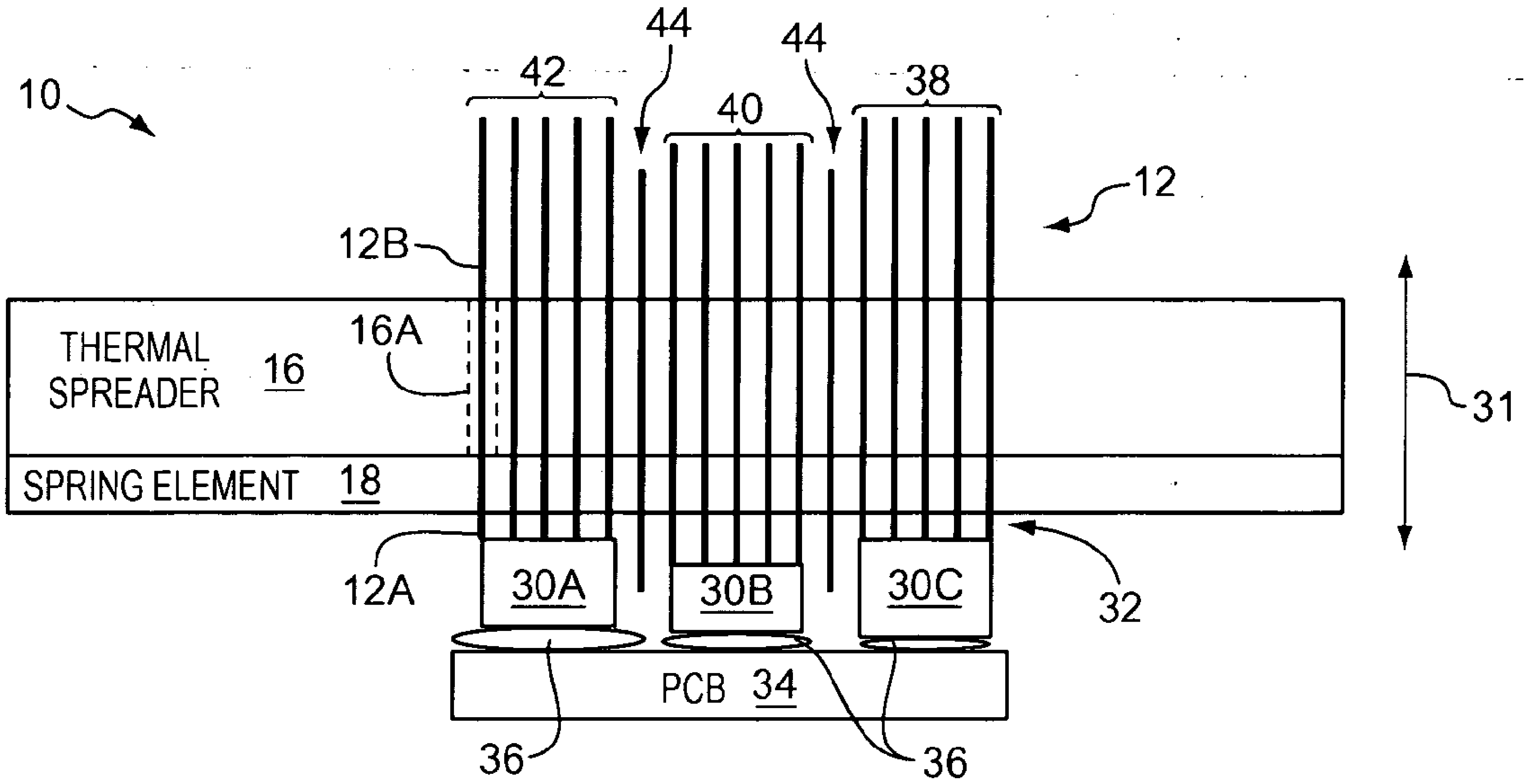

10
42
44
40
44
38
12
12B
THERMAL SPREADER 16
16A
31
SPRING ELEMENT 18
12A
30A
30B
30C
32
PCB 34
36
36

FIG. 4

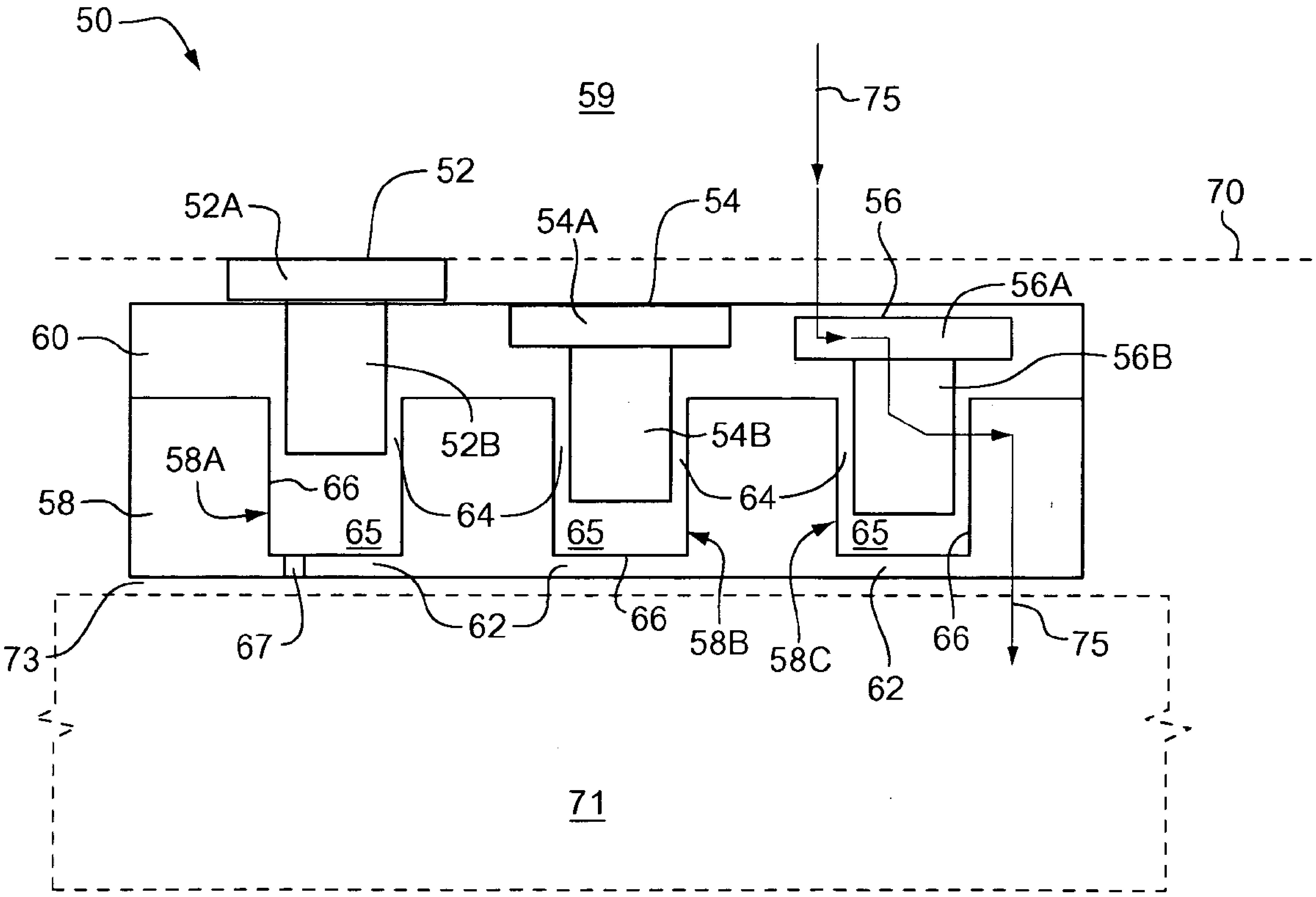
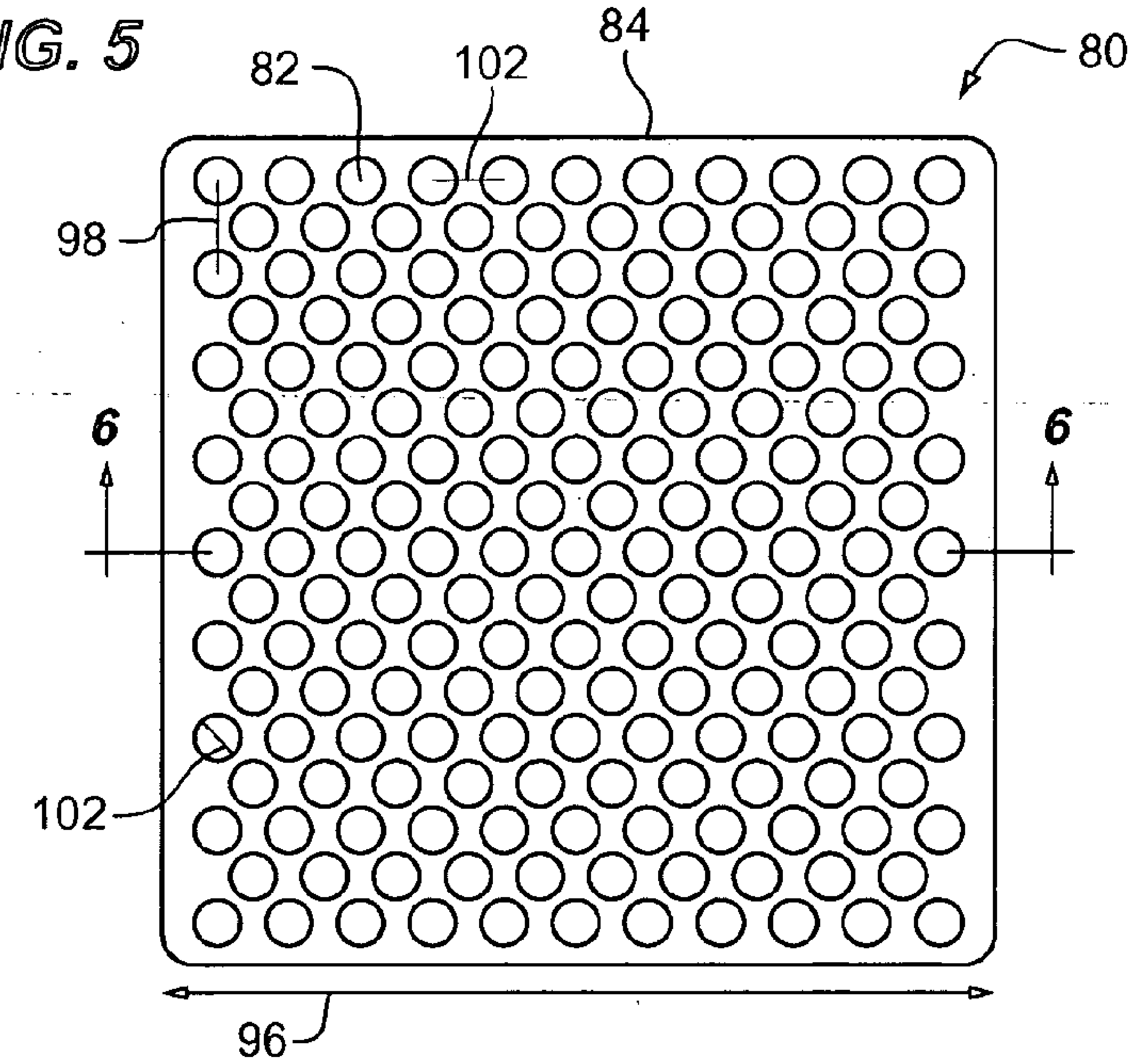

50
59
75
52
52A
54A
54
56
70
56A
60
56B
52B
54B
58A
66
58
65
64
65
64
65
73
67
62
66
58B
58C
62
66
75
71

FIG. 5



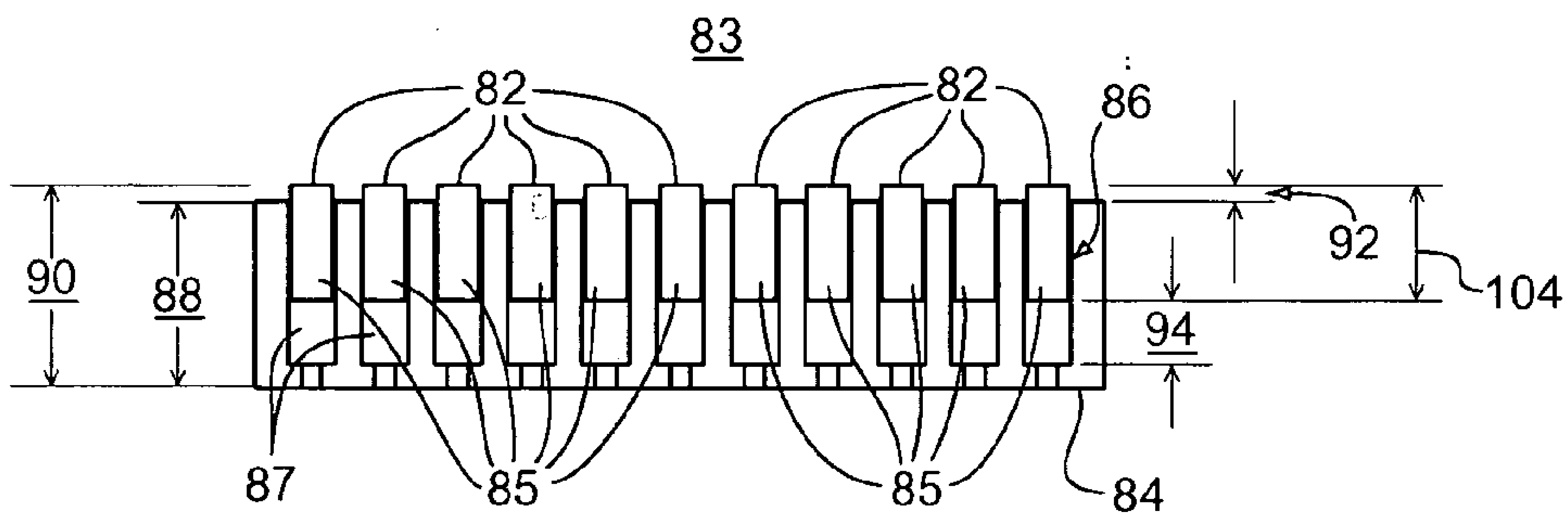


FIG. 6

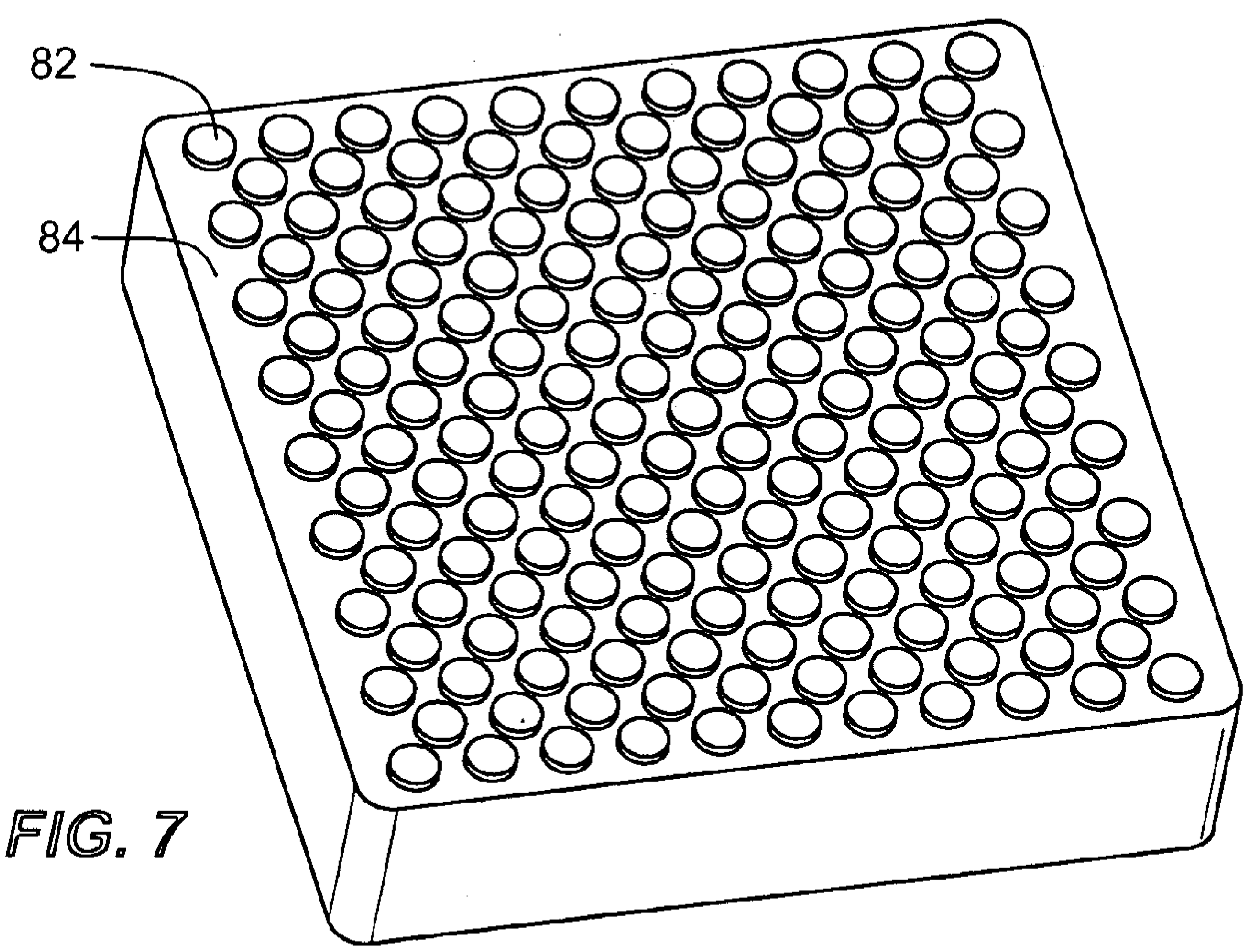


FIG. 7

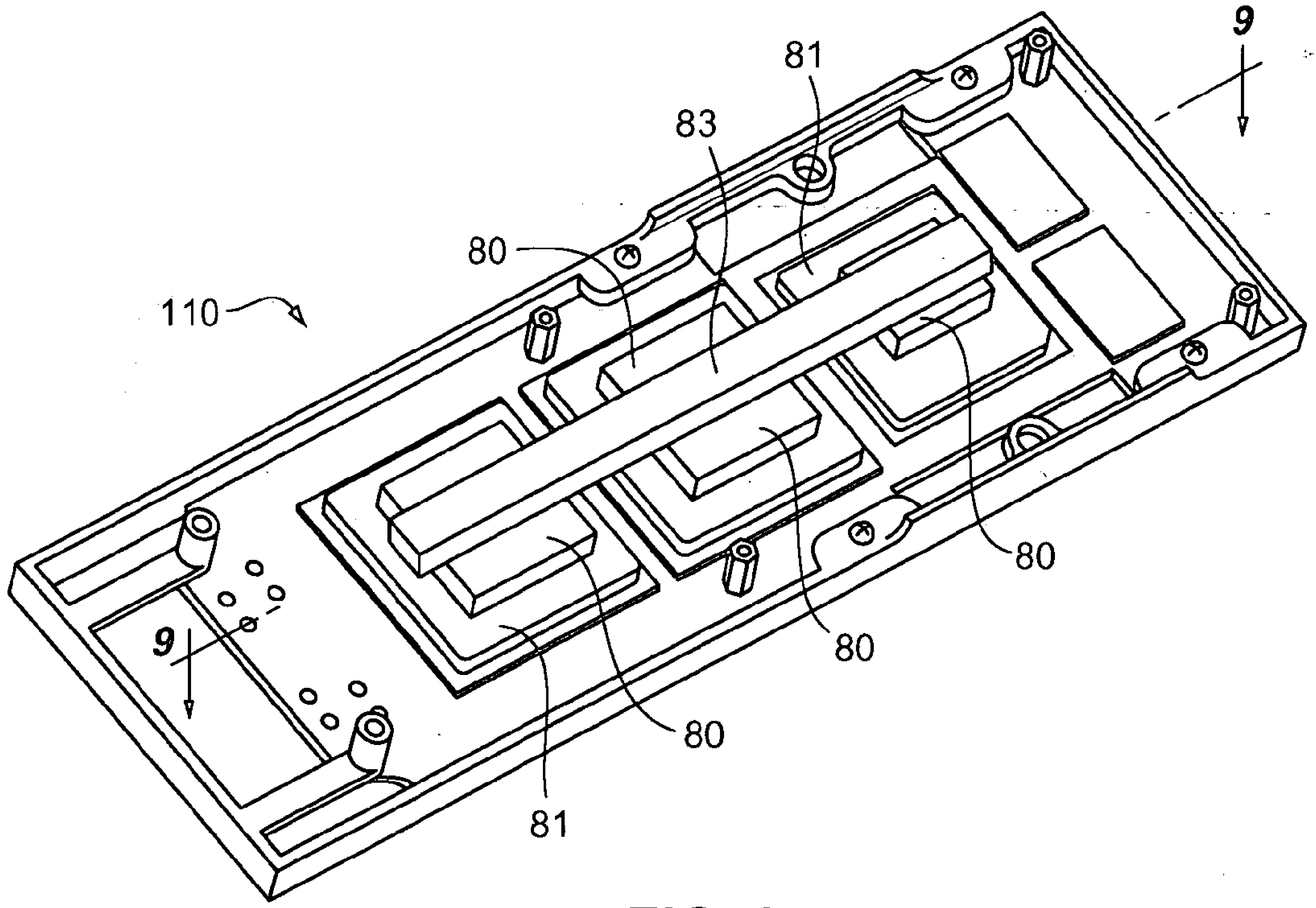

9
81
83
80
110
80
9
80
80
81

FIG. 8

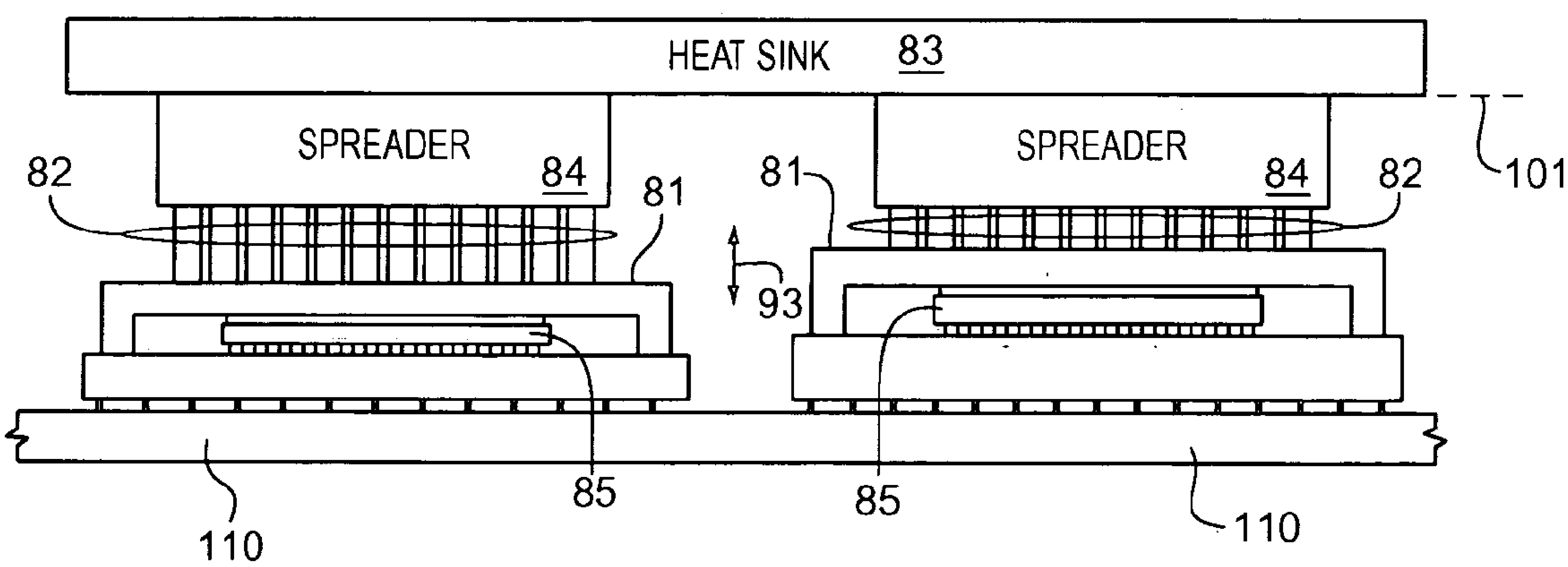

HEAT SINK 83
SPREADER 84
SPREADER 84
82
81
81
82
101
93
85
85
110
110

FIG. 9

FIG. 10

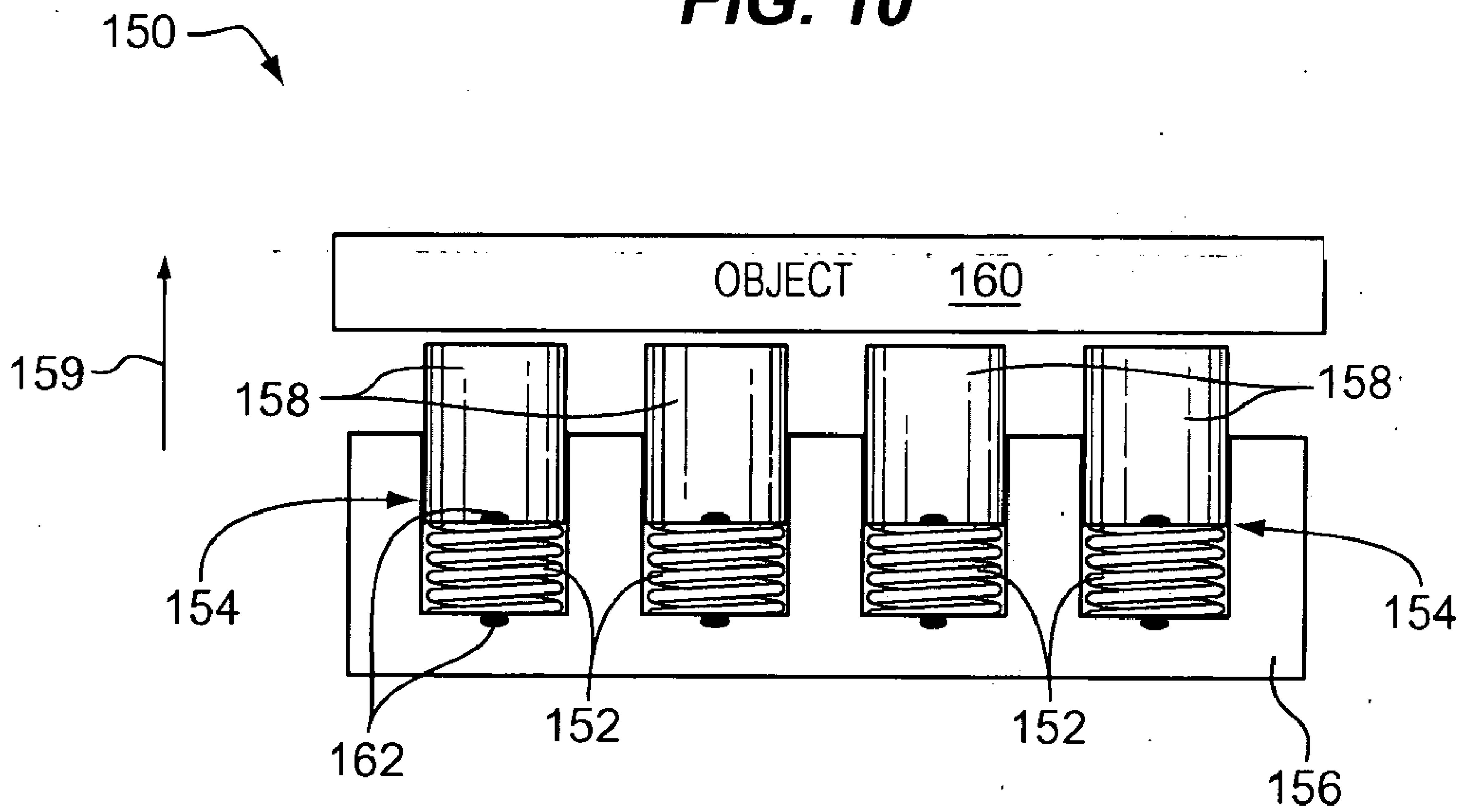
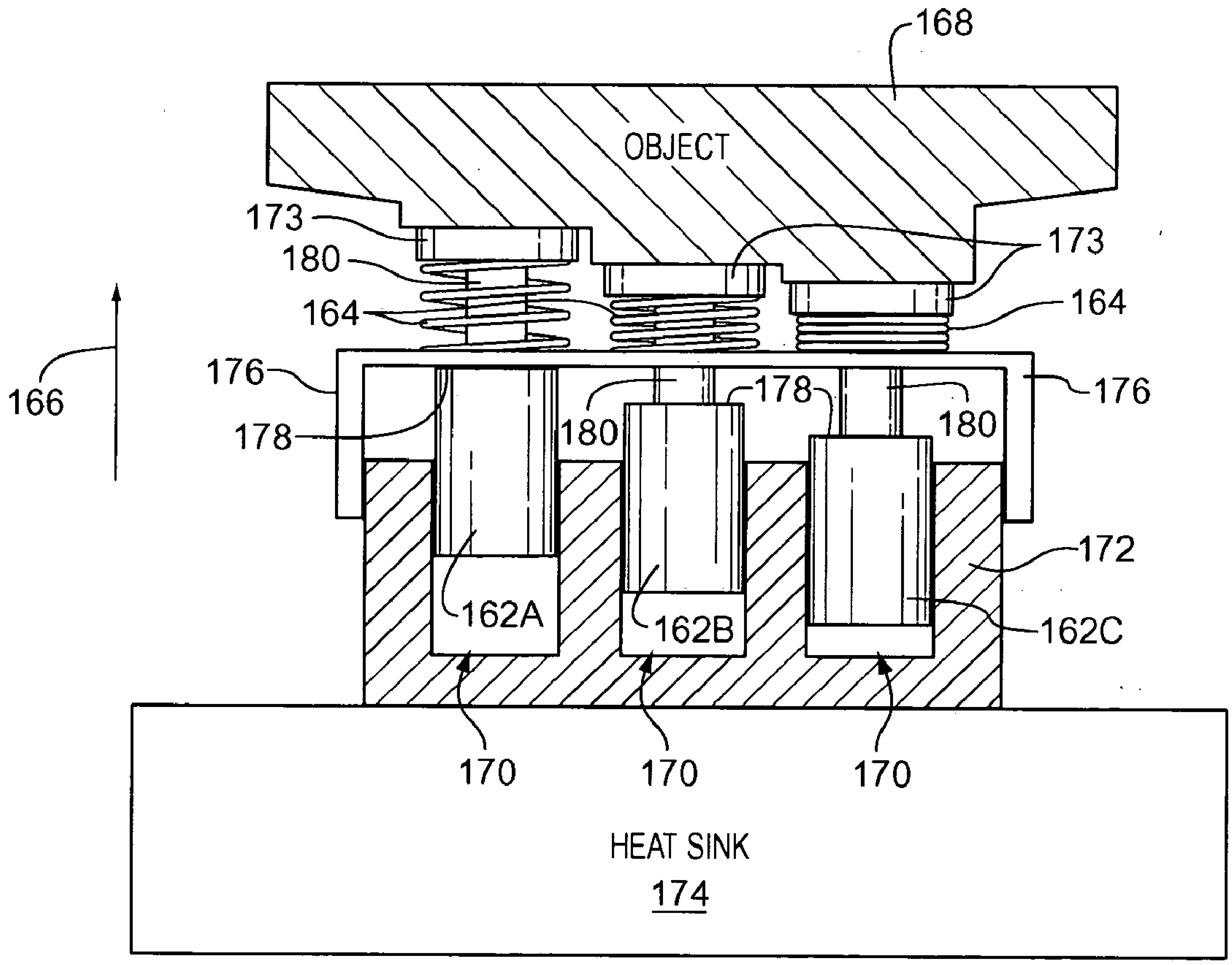

150
OBJECT 160
159
158
158
154
154
162
152
152
156

FIG. 11


168
OBJECT
173
173
180
164
164
166
176
176
178
178
180
180
172
162A
162B
162C
170
170
170
HEAT SINK
174

THERMAL TRANSFER INTERFACE SYSTEM AND METHODS

RELATED APPLICATIONS

[0001] This application is a divisional of U.S. patent Ser. No. 10/074,642; entitled THERMAL TRANSFER INTERFACE SYSTEM AND METHODS; Attorney Docket No. 10018060-1, the aforementioned application is incorporated herein by reference thereto.

BACKGROUND OF THE INVENTION

[0002] Electronic systems often incorporate a semiconductor package (e.g., including a semiconductor die) that generates significant thermal energy. System designers spend considerable effort to provide sufficient heat dissipation capability in such systems by providing a thermally conductive path from the package to a heat sink. A heat sink may for example be a ventilated conductive plate or an active device such as a thermoelectric cooler.

[0003] Certain difficulties arise when these electronic systems utilize multiple dies and other heat-generating devices. More particularly, each die and device must have its own heat dissipation capability; this for example complicates system design by requiring that there is adequate ventilation and/or thermally conductive paths and heat sinks for the entire system. Such ventilation, thermal paths and heat sinks increase cost and complexity, among other negative factors.

[0004] Certain difficulties also arise in multiple die electrical systems because of mechanical tolerance build-up. That is, the physical mounting of multiple dies on a printed circuit board (PCB), for example, results in some minute misalignment between reference surfaces intended to be co-aligned. Accordingly, any attempt to use a common heat sink must also accommodate the tolerance build-up to ensure appropriate thermal transfer across the physical interface. Tolerance build-up may for example occur due to the soldering that couples the dies to the PCB, and/or due to manufacturing inconsistencies in the rigid covers or "lids" which sometimes cover individual dies. In any event, a thermal sink coupled to multiple dies should account for tolerance issues at the interface between the sink and the multiple dies in order to properly dissipate generated thermal energy. Designers of the prior art thus often overcompensate the thermal design to accommodate worst-case interface tolerance issues. Once again, this increases cost and complexity in the overall electrical system, among other negative factors.

[0005] The invention provides certain features to advance the state of the art by providing, among other features, a thermal transfer interface system for dissipating heat from multiple dies in an electrical system. Other features of the invention will be apparent in the description which follows.

SUMMARY OF THE INVENTION

[0006] In one aspect, the invention provides a thermal transfer interface. A thermal spreader forms a plurality of passageways. A spring element couples with the spreader. A plurality of thermally conductive pins are included and arranged for movement along the passageways. Each of the pins has a head and a shaft moving with the spring element. At least part of the shaft is internal to the passageway; and it forms a gap with an internal surface of the passageway. The gap may be an air gap or filled with a thermally conductive material such as thermal grease. In operation, the pin heads collectively and macroscopically conform to an object to transfer heat from the object to the thermal spreader through the passageway gap formed between the heat sink and each of the plurality of pins. In one aspect, the spreader is a heat sink; for example the spreader is actively cooled by liquid or ventilated by air to dissipate heat from the pins. In another aspect, a separate heat sink couples with the spreader to dissipate the heat from the spreader. In still another aspect, the pins extend through the spreader so that they extend from the object through the spreader and into a cooling medium (e.g., air); the pins extending into the cooling medium act to dissipate heat and draw thermal energy from the spreader and/or object to the medium.

[0007] The spring element of one aspect forms a layer with a substantially planar face. One or more of the pin heads protrude from the face in a direction away from the spreader. In another aspect, one or more of the pin heads are substantially flush with the face. In yet another aspect, one or more of the pin heads are embedded within the spring element. Thermal grease or other conductive medium may assist in thermal heat transfer from the object to the pins and/or spring element.

[0008] In yet another aspect, the pin head is slightly smaller than the remainder of the pin shaft so that a pin shoulder is formed. A retaining element couples to the spreader to retain the pin shafts between the spreader and the retaining element; the pins axially move along the passageway to couple with the object, as above, but the pin element will extend from the spreader only until the shoulder abuts the retaining element.

[0009] In another aspect, the passageways are sealed to form a cavity and the pin shafts seat in the passageways such that a filler medium pressurizes the pins to form the spring element. The filler medium may be air or a thermally conductive medium such as thermal grease. A small gap in the spreader may be included with one or more passageways to vent over-pressurization of the filler medium.

[0010] In still another aspect, the spring element includes a plurality of springs disposed between the spreader and the pin heads. In another aspect, the spring element includes a plurality of springs disposed within the passageways between the spreader and the pin shafts.

[0011] The pin shafts may be rectangularly shaped. The passageways have a similar though slightly larger shape to accommodate the pin shaft dimensions. As an alternative, the pin shafts are cylindrical in shape and the passageways are also cylindrical, through slightly larger in size to accommodate pin movement of the shaft therein.

[0012] The invention has particular advantages in dissipating heat from objects in the form of one or more semiconductor dies. In one aspect, a heat sink couples to the spreader. The heat sink may for example be an active thermoelectric cooler, a cooled thermally conductive element (e.g., a thermally conductive block cooled by liquid), or a passive thermally dissipating metal block.

[0013] The invention has further advantages in that it may be inverted depending upon desired application. That is, the invention of one aspect is a thermal interface: it transfers heat from one side to another irrespective of applied orientation.

[0014] In one aspect, the spring element is a thermally conductive sponge-like material. The spring element may one or a combination of various forms of spring elements disclosed herein.

[0015] The invention also provides a method for transferring thermal energy from a body to a thermal spreader and/or heat sink, including the steps of: biasing a plurality of pins against a surface of the object so that the plurality of pins contact with, and substantially conform to, a macroscopic surface of the object, and communicating thermal energy from the object through the pins to a thermal spreader forming a plurality of air gaps with the plurality of pins. The step of biasing a plurality of pins against a surface of an object may include the step of biasing the plurality of pins against a plurality of dies or semiconductor packages coupled with a printed circuit board or other electrical apparatus. The thermal spreader may act as the heat sink with the pins; or, in another aspect, a separate heat sink couples with the spreader.

[0016] The invention is next described further in connection with preferred embodiments, and it will become apparent that various additions, subtractions, and modifications can be made by those skilled in the art without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] A more complete understanding of the invention may be obtained by reference to the drawings, in which:

[0018] **FIG. 1** shows a cross-sectional side view of one thermal interface system constructed according to the invention;

[0019] **FIG. 2** shows a top view of the system of **FIG. 1**;

[0020] **FIG. 3** shows the system of **FIG. 1** used to dissipate heat from a plurality of dies, in accord with one embodiment of the invention;

[0021] **FIG. 4** shows a side view of another thermal interface system of the invention;

[0022] **FIG. 5** shows a top view of one other thermal interface system of the invention;

[0023] **FIG. 6** shows a cross-sectional view of the thermal interface system of **FIG. 5**;

[0024] **FIG. 7** shows a perspective view of the thermal interface system of **FIG. 5**;

[0025] **FIG. 8** shows a perspective view of several of the thermal interface systems of **FIG. 5** operationally connected to dissipate heat from semiconductor packages of a printed circuit board;

[0026] **FIG. 9** shows a cross-sectional view of the system of **FIG. 8** coupled with two of the packages;

[0027] **FIG. 10** shows another spring element configuration for biasing pins according to one thermal interface system of the invention; and

[0028] **FIG. 11** shows another spring-element configuration for biasing pins according to one thermal interface system of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

[0029] **FIG. 1** shows a cross-sectional side view of one thermal interface system **10** of the invention. System **10** includes a plurality of thermally conductive pins **12** that interface with an object **14** to transfer heat from object **14** to a thermal spreader **16**. A spring element **18** facilitates coupling between pins **12** and object **14** such that pins **12** collectively conform with a surface **14A** of object **14**, even if surface **14A** is non-planar, such as shown. As used herein, each of pins **12** may for example be described with a head **12A** and a shaft **12B**, such as shown in **FIG. 1**. By way of operation, for those pins **12** that are in range of object **14**, pin heads **12A** are adjacent to, or in contact with object **14**, while shafts **12B** of pins **12** have at least some portion adjacent to, or in contact with thermal spreader **16**. In one embodiment, pins **12** pass within a like plurality of passageways **16A** of spreader **16**. For purposes of illustration, only one passageway **16A** is shown and identified in **FIG. 1**; pins **12** slide within passageways **16A** to accommodate movement of pins **12**, and/or element **18**, in conformal contact with object **14**.

[0030] **FIG. 2** shows a top view of object **14** and system **10**. For purposes of illustration, spring element **18** is transparently shown so as to clearly show the plurality of passageways **16A** with pins **12**. In operation, system **10** serves to dissipate heat from object **14** to spreader **16**. Pins **12** are in thermal communication with object **14** when pins **12** (a) directly contact object **14**, (b) couple to object **14** through a thermally conductive medium (e.g., thermal grease or a thermally conductive spring element **18**), and/or (c) are close to object **14** such that the air gap between pin heads **12A** and object **14** does not substantially prohibit heat transfer. It is not necessary that every pin **12** thermally communicate with object **14**. System **10** utilizes a plurality of pins that number in the tens, hundreds, thousands or millions; collectively these pins macroscopically conform to surface **14A** of object **14** to transfer heat from object **14**, through a plurality of pins **12** and to spreader **16**.

[0031] Thermal spreader **16** may also form a heat sink to draw heat from object **14**. Pins **12** may also form a heat sink; for example, by communicating air **19** across pins **12** extending through spreader **16**, as shown, pins **12** are cooled to collectively function as a heat sink. Optionally, a separate heat sink **21** may couple to thermal spreader **16**, as shown, to dissipate or assist in drawing heat from object **14**.

[0032] Object **14** may for example be a semiconductor die or package, such as described in connection with **FIG. 3**. Spring element **18** may be replaced or augmented with different spring-like elements as described in more detail below.

[0033] **FIG. 3** shows system **10** in another configuration, where the object is a plurality of objects **30A-30C**. In one embodiment of the invention, objects **30A-30C** are semiconductor packages and/or dies (collectively "dies"**30**). As shown, objects **30** are beneath system **10**, illustrating that system **10** may be configured in multiple orientations without departing from the scope of the invention; by way of example, system **10** may mount on top of dies **30** using its weight or other force to couple pins **12** to dies **30**. Each of dies **30** is shown with a different physical size and with a different physical separation **32** from system **10**, as compared with other dies **30**, so as to illustrate that system **10** may accommodate physical non-uniformities and uneven surfaces of objects **30**. Dies **30** may for example couple with a PCB **34** via solder or socket connections **36**, as shown; solder or socket connections **36**, and the manufacturing build-up tolerances of PCB **34** and dies **30**, may cause the variations in separation differences **32** between the multiple dies and system **10**, such as shown. Pins **12** axially move along direction **31**, within passageways **16A** and relative to thermal spreader **16** to accommodate conformal contact with object **30**. As above, spreader **16** and/or pins **12** may function as a heat sink, or a separate heat sink (e.g., sink **21**, **FIG. 1**) may couple with spreader **16**.

[**0034**] Spring element **18** serves to bias pins **12** in accommodating physical separation differences **32** to relevant pins **12** so as to ensure macroscopic conformity (i.e., where multiple pins conform to an object surface larger than any one pin) between pins **12** and outer surfaces of dies **30**. By way of example, spring element **18** biases pins **38** with die **30**C, spring element **18** biases pins **40** with die **30**B, and spring element **18** biases pins **42** with die **30**A. Pins **44** are not engaged with object **30** and are in this example maximally extended from system **10**. Other pins **12**—not shown in **FIG. 3**—may or may not connect with object **30**.

[**0035**] **FIG. 4** shows a cross-sectional view of one thermal interface system **50** of the invention. System **50** is shown with three different pin configurations, one for each of pins **52**, **54**, **56**. Though not required, typically each pin is in a same configuration (e.g., each of pins is in the configuration of pin **52**, pin **54** or **56**); in addition, only three pins **52**, **54**, **56** are shown when system **50** generally has many more pins that enable coupling to micro-features of an object **59** (e.g., object **14**, **FIG. 1**). Pins **52**, **54**, **56** couple with a thermal spreader **58** via a spring pad **60**, as shown (other spring elements may augment or replace pad **60**, such as described below). In the configuration of pin **52**, a head **52**A of pin **52** extends from spring pad **60** while a shaft **52**B of pin **52** extends at least partially within a passageway **58**A of spreader **58**. In the configuration of pin **54**, a head **54**A of pin **54** is coplanar with spring pad **60** while a shaft **54**B of pin **54** extends at least partially within a passageway **58**B of heat sink **58**. In the configuration of pin **56**, a head **56**A of pin **56** is embedded within spring pad **60** while a shaft **56**B of pin **56** extends at least partially within a passageway **58**C of heat sink **58**. In each pin configuration, the shaft length of the pin **52** is sufficiently long to ensure thermal transfer between the shaft and spreader **58**.

[**0036**] Passageways **58**A, **58**B, **58**C are shown with a closed end **62**, though the passageways(s) may extend entirely through spreader **58** as a matter of design choice (e.g., as in **FIG. 1**). In the configuration of **FIG. 4**, passageways **58**A-**58**C thus form a cavity **65** within spreader **58**. Cavity **65** may itself function as a spring element. By way of example, air or other thermally conductive medium may fill cavity **65** and compress/expand with pin movement within passageways **58**A-**58**C. A small vent **67** may be included within end **62** as a matter of design choice to vent over-pressurization of material in cavity **65**; vent **67** is shown with only one passageway **58**A for ease of illustration even though system **50** may include multiple vents **67** as a matter of design choice.

[**0037**] Each of pins **52**, **54**, **56** form a gap **64** with an internal surface **66** of respective passageways **58**A, **58**B, **58**C; gap **64** is formed between the smaller diameter of shaft **52**B, **54**B, **56**B within the larger diameter of respective passageways **58**A, **58**B, **58**C. By way of example, each of pin shafts **52**B, **54**B, **56**B may have a cylindrical shape with a diameter of about 0.06 inch, and each passageway **58**A, **58**B, **58**C then has a diameter of between about 0.0605 to 0.065 inch. Gaps **64** (and/or cavities **65**) may be filled with thermally conductive grease, gas, air or other thermally conductive medium. Pin shafts **52**B, **54**B, **56**B may also be rectangular in shape; passageways **58**A, **58**B, **58**C accordingly would-also be rectangular, though larger in size to accommodate pin movement therein.

[**0038**] Pins **52**, **54**, **56** may move with spring element **60**. Spring element **60** is for example a thermally conductive sponge-like material, though a non-conductive pad may also be used so long as an aperture cut into the pad permits thermal energy transfer from object **59** to the relevant pin **52**. A layer **70** of thermally conductive grease may cover over element **60** and pins **52**, **54**, **56** to encourage transfer of thermal energy from object **59** to spreader **58**; grease **70** is particularly useful in the configurations of pin **52**, **54** as spring element **60** can provide thermal microscopic contact between object **59** and pin **56**.

[**0039**] Though not required, system **50** may include a heat sink **71** to draw thermal energy from pins **52** and spreader **58**. Thermal grease **73** can improve thermal conductivity between spreader **58** and heat sink **71**, as shown. Illustratively, thermal energy **75** from object **59** travels through layer **70**, into pins **52**, **54**, **56**, out of pin shafts **52**B, **54**B, **56**B and into spreader **58** through the gap **64** between shafts **52**B, **54**B, **56**B, and into heat sink **71**, such as shown.

[**0040**] The interfaces of **FIG. 1**-**FIG. 4** take advantage of the physics of thermal resistance, which equals L/KA (where L is the path length of heat flow, K is the conductivity, and A is the area though which the heat flows). A way to decrease thermal resistance of interfaces **10**, **50** is therefore to decrease path length L or to increase area A. Since interface **10**, **50** is already very close to object **59** from which it dissipates heat, L is already small; the invention thus has particular advantages in increasing area A. Area A is approximately equal to the number of pins forming the interface times the barrel area of the pin shafts forming gap **64**. By ensuring gap **64** is small, there is negligible heat resistance across the gap, and spreader **58** maximally dissipates heat from object **59**. Increasing the number of pins in interface **50** increases heat transfer efficiency by increasing the cumulative area of gaps **64** between object **59** and spreader **58**; this efficiency improves further when gaps **64** are filled with thermally conductive grease or paste. Accordingly, the interfaces of the invention may utilize hundreds, thousands or millions of pins, as a matter of design choice. Pins may also be arranged in any pattern with the spreader, such as shown by the configuration of pins **12**, **FIG. 2**, or pins **82**, **FIG. 7**. The pins are thermally conductive; accordingly, copper, aluminum or other thermally conductive material provides acceptable materials for construction of the pins.

[**0041**] A thermal pad of the prior art may exhibit a thermal resistance of between about 2-5 inches-squared per Watt per degree C. while accommodating surface irregularities of only about 0.06 inch. A prior art thermal pad with a thickness exceeding about 0.002 inch exhibits thermally insulating properties or behaviors compounding the undesirable issues discussed above relative to the prior art. The interfaces **10**, **50** of the invention, on the other hand, can for example improve such thermal resistances to at least about 0.2-0.5 inches-squared per Watt per degree C., and further accommodate macroscopic surface variations and differences (e.g., differences **32**, **FIG. 3**) exceeding 0.06 inch.

[**0042**] **FIG. 5** shows a top view of one thermal interface system **80** of the invention; **FIG. 6** shows a cross-sectional view of system **80**; and **FIG. 7** shows a perspective view of system **80**. A plurality of pins **82** conform to a surface of an object **83** (e.g., object **14**, **FIG. 1**) so as to dissipate heat from object **83** to a thermal spreader **84**. Each of pins **82** has a shaft **85** within respective passageways **87** of spreader **84**; sizing of pins **82** within passageways **87** forms a small gap **86** between each pin **82** and spreader **84**. Gap **86** may be filled with thermally conductive material such as grease. In one acceptable configuration of system **80**, a dimension **88** is 6 mm, a dimension **90** is 6.5 mm, a dimension **92** is 0.86 mm, a dimension **94** is 2.1 mm, a dimension **96** is 25.4 mm, a dimension **98** is 1.35 mm, a diameter **100** of each of pins **82** is 0.084 mm, a dimension **102** is 1.70 mm, and a pin length dimension **104** is 1.52 mm. For purposes of clarity, a spring element is not shown in **FIG. 5** and **FIG. 6**; however a spring element such as spring element **60**, **FIG. 4**, may for example be included with system **80** within the space provided by dimension **92**. Helical springs such as shown in **FIG. 9** or **FIG. 10** may also be used.

[**0043**] **FIG. 8** illustrates how two or more systems **80** may for example dissipate heat from multiple semiconductor packages **81** of a printed circuit board **110**. As shown, three thermal interface systems **80** couple to packages **81** to dissipate heat generated thereby. Each package **81** may include a die (**85**, **FIG. 9**) that is typically smaller in surface area than each of systems **80**. That is, each package **81** may be larger than system **80** as a matter of design choice; generally, however, each system **80** at least covers the surface area of die **85** within package **81**. As described in more detail below, a common heat sink **83** may couple with multiple systems **80**, as shown, to dissipate heat from spreaders **84**.

[**0044**] **FIG. 9** shows a cross-sectional side view of two thermal interface systems **80** coupled with two packages **81**; a semiconductor die **85** is within each package **81**, as shown. Pins **82** move within spreaders **84** to accommodate the height differences **93** of packages **81**; accordingly, common heat sink **83** may couple to a substantially flat plane **101** along the top of spreaders **84**. Thermal grease at plane **101** between spreaders **84** and heat sink **83** facilitate thermal communication therebetween.

[**0045**] Those skilled in the art should appreciate that changes may be made to the above description without departing from the scope of the invention. By way of example, spring elements **18**, **60** may be replaced, or augmented by tiny springs disposed within passageways **16**A, **58**A, **58**B, **58**C so as to outwardly push pins outward from heat sink **16**, **58**, **84** in conforming to a heat generating object **14**, **30**, **59**, **83**. A configuration such as this is shown in **FIG. 10**. **FIG. 10** specifically illustrates one thermal interface system **150** of the invention that incorporates a plurality of spring elements **152** disposed with passageways **154** of a thermal spreader **156** to bias pins **158** outwardly (along direction **159**) from spreader **156** to conform to an object **160**. Elements **152** couple with spreader **156** and pins **158** via connectors **162** so that pins **158** appropriately bias against object **160** to collectively conform to surface **160A** by appropriate compression against spreader **156**.

[**0046**] Spring elements may also be utilized underneath the heads of the pins, and between the heads and the spreader, as shown in the thermal interface system **161** of **FIG. 11**. Three pins **162A-162**C are shown in **FIG. 11**. A plurality of springs **164** generate compressive forces to bias pins **162** along direction **166**, as shown, for thermal communication with an uneven object **168**; springs **164** compress between spreader **172** (or against element **176** described below) and pin head **163** to accommodate the uneven surface of object **168**. Like above, pins **162** move along direction **166** and within a like plurality of passageways **170** of a thermal spreader **172**. A heat sink **174** may optionally couple to spreader **172** to facilitate cooling of object **168**.

[**0047**] **FIG. 11** also illustrates one pin embodiment of a thermal interface system to retain pins **162** relative to spreader **172**. In this embodiment, a retaining element **176** couples with spreader **172**. Pins **162** are shown with a shoulder **178** that abuts element **176** when extended as in pin **162**A; element **176** forms apertures to accommodate passage of the above-shoulder extensions **180** of pins **162**. Accordingly, the retaining embodiment of **FIG. 11** ensures that pins **162** do not completely separate from spreader **172**.

[**0048**] Since certain changes may be made in the above methods and systems without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing be interpreted as illustrative and not in a limiting sense. It is also to be understood that the following claims are to cover all generic and specific features of the invention described herein, and all statements of the scope of the invention which, as a matter of language, might be said to fall there between.

What is claimed is:

1. A thermal transfer interface, comprising:

a thermal spreader forming a plurality of passageways;

a spring element coupled with the spreader; and

a plurality of thermally conductive pins for the passageways, each of the pins having a head and a shaft moving with the spring element, at least part of the shaft being internal to the passageway and forming a gap with an internal surface of the passageway, wherein the pin heads collectively and macroscopically conform to an object coupled thereto to transfer heat from the object to the spreader through the passageway gap formed between the spreader and each of the plurality of pins.

2. An interface of claim 1, the spring element forming a layer with a substantially planar face, each of the pin heads being substantially flush with the face.

3. An interface of claim 1, the spring element forming a layer with a substantially planar face, each of the pin heads recessed within the spring element.

4. An interface of claim 1, the spring element formed of non-conductive material and forming one or more apertures for thermal energy transfer between the object and the pin heads.

5. An interface of claim 1, the spreader comprising a ventilated metal block.

6. An interface of claim 1, the spring element comprising a plurality of springs disposed with the passageways for biasing the pins outwardly from the spreader towards the object.

7. An interface of claim 1, the spring element comprising a plurality of springs disposed between the pin heads and the spreader for biasing the pins outwardly from the spreader towards the object.

8. An interface of claim 6, each of the pins forming a shoulder, and further comprising a retaining element for abutting the shoulder in defining a maximal extension of pins.

9. An interface of claim 7, each of the pins forming a shoulder, and further comprising a retaining element for abutting the shoulder in defining a maximal extension of pins.

10. An interface of claim 1, the thermal spreader comprising at least one vent coupled with at least one of the passageways, to vent pressure from the one passageway.

11. An interface of claim 1, one or more of the pin shafts having non-cylindrical shape, each of the passageways having a substantially matched non-cylindrical shape to accommodate motion of the shafts therethrough.

12. An interface of claim 1, the pin heads arranged in a geometric pattern that covers an area extending beyond a region of contact between the pin heads and the object.

13. An interface of claim 1, further comprising thermal grease disposed within the gap.

14. An interface of claim 1, the object comprising a semiconductor die.

15. An interface of claim 1, the object comprising a plurality of dies, wherein a first set of the pins contact the plurality of dies, and wherein a second set of pins do not contact the dies.

16. A method for transferring thermal energy from a body to a heat sink, comprising the steps of: biasing a plurality of pins against a surface of the object so that the plurality of pins contact with, and substantially conform to, a macroscopic surface of the object, and communicating thermal energy from the object through the pins to a thermal spreader forming a plurality of gaps with the plurality of pins.

17. A method of claim 16, the step of biasing comprising biasing a plurality of pin heads against the object utilizing a plurality of springs.

18. A method of claim 16, the step of biasing comprising utilizing a spring element formed of thermally conductive material with a substantially planar face, each of the pin heads being substantially flush with the face.

19. A method of claim 16, the step of biasing comprising utilizing a spring elemen formed of thermally conductive material with a substantially planar face, each of the pin heads recessed within the spring element.

20. A method of claim 16, the step of biasing comprising utilizing a plurality of springs disposed between pin heads of the pins and the spreader.

21. A method of claim 16, further comprising utilizing a thermal spreader having at least one vent coupled with at least one passageway through the thermal spreader, to vent pressure from the passageway.

22. A method of claim 16, the step of biasing comprising utilizing pins with non-cylindrical shape.

23. A method of claim 16, further comprising the step of disposing thermal grease within the gap.

24. A method of claim 16, the object comprising a semiconductor die.

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