US 20190081061A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2019/0081061 A1**

(43) **Pub. Date: Mar. 14, 2019**

Tessariol et al.

(54) **DEVICE, A METHOD USED IN FORMING A CIRCUIT STRUCTURE, A METHOD USED IN FORMING AN ARRAY OF ELEVATIONALLY-EXTENDING TRANSISTORS AND A CIRCUIT STRUCTURE ADJACENT THERETO**

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(21) Appl. No.: **15/705,179**

(22) Filed: **Sep. 14, 2017**

Publication Classification

(51) **Int. Cl.**

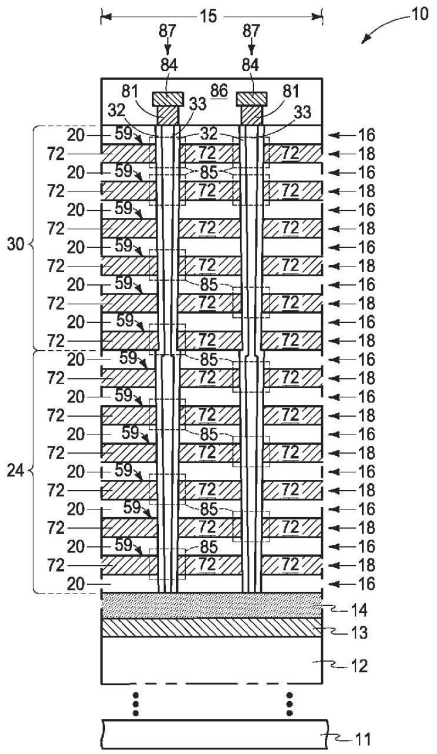
H01L 27/11582	(2006.01)
H01L 21/768	(2006.01)
H01L 21/311	(2006.01)
H01L 27/11556	(2006.01)
H01L 21/02	(2006.01)
H01L 29/10	(2006.01)
H01L 23/522	(2006.01)
H01L 23/528	(2006.01)

(52) **U.S. Cl.**

CPC .. ***H01L 27/11582*** (2013.01); ***H01L 21/76802*** (2013.01); ***H01L 21/76877*** (2013.01); ***H01L 21/31111*** (2013.01); ***H01L 23/528*** (2013.01); ***H01L 27/11556*** (2013.01); ***H01L 21/02636*** (2013.01); ***H01L 29/1037*** (2013.01); ***H01L 23/5226*** (2013.01); ***H01L 21/76895*** (2013.01)

(57) **ABSTRACT**

A device comprises an array of elevationally-extending transistors and a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array. The circuit structure comprises a stair step structure comprising vertically-alternating tiers comprising conductive steps that are at least partially elevationally separated from one another by insulative material. Operative conductive vias individually extend elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers and individually electrically couple to an electronic component below the vertically-alternating tiers. Dummy structures individually extend elevationally through one of the conductive steps at least to the bottom of the vertically-alternating tiers. Methods are also disclosed.



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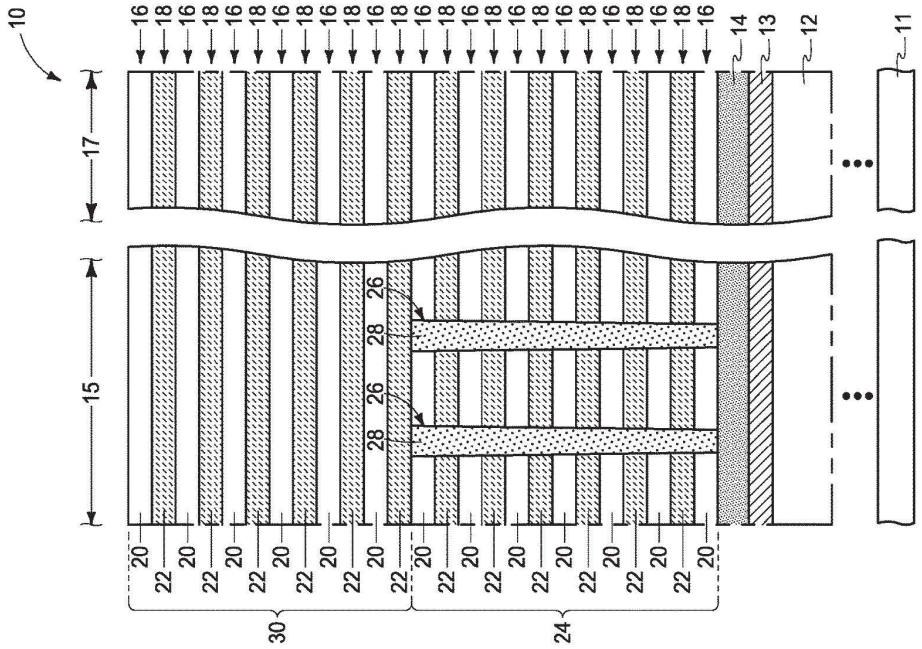
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FIG. 2

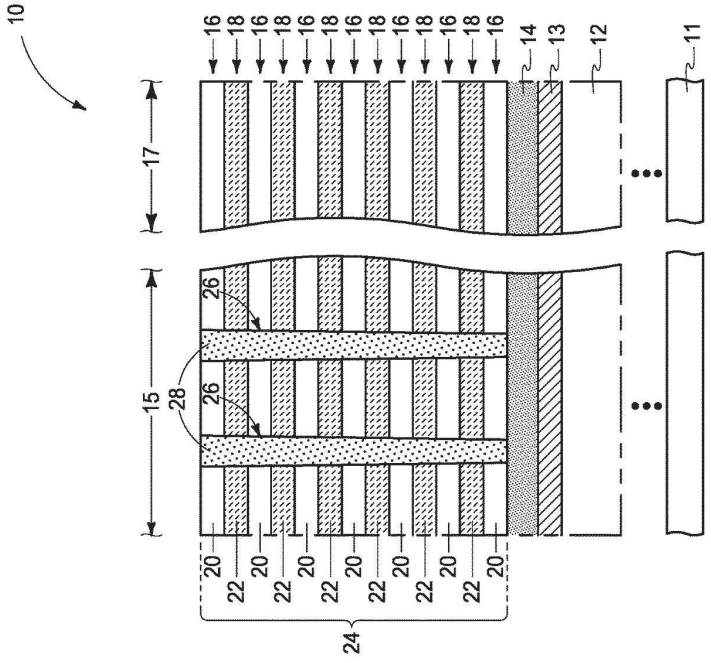
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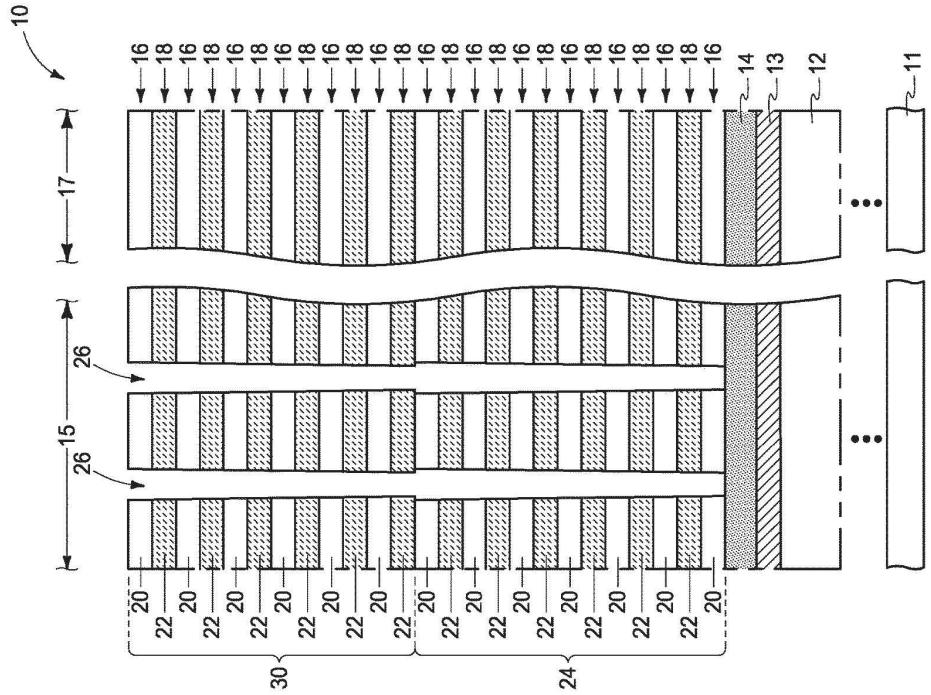
FIG. 1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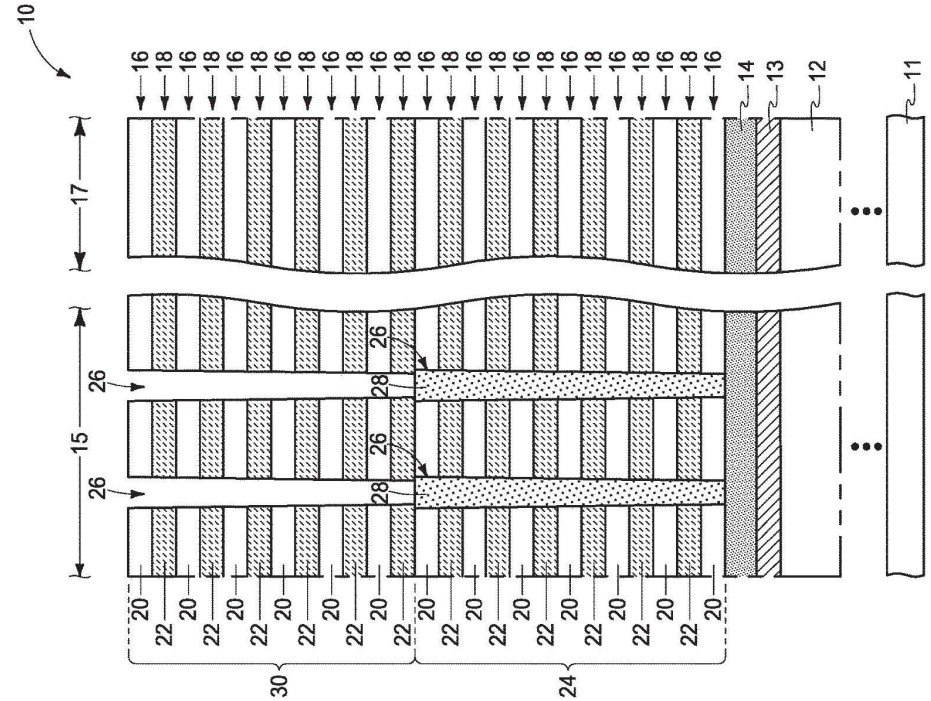
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FIG. 3

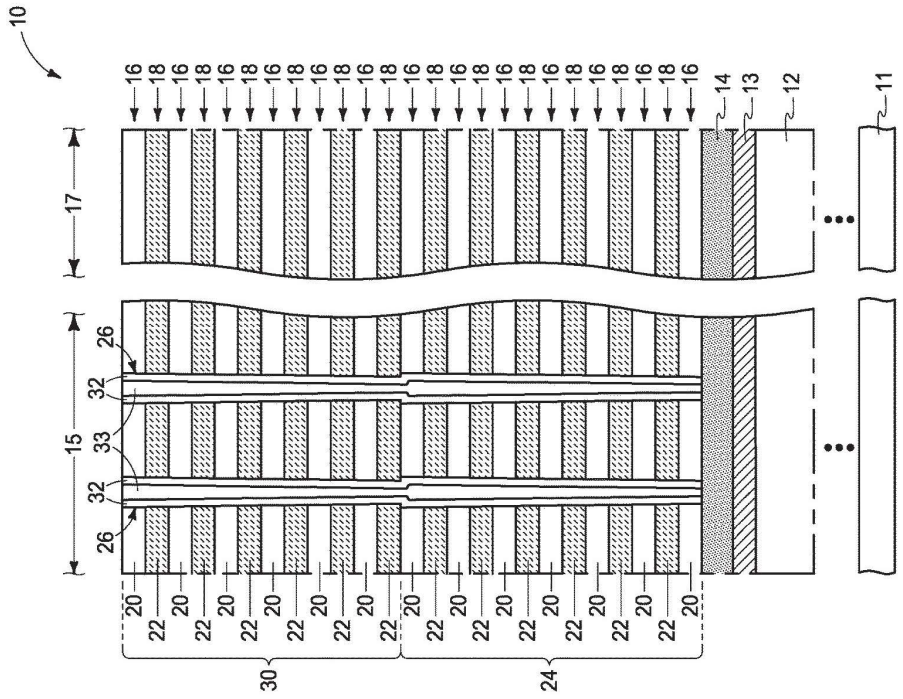

FIG. 5

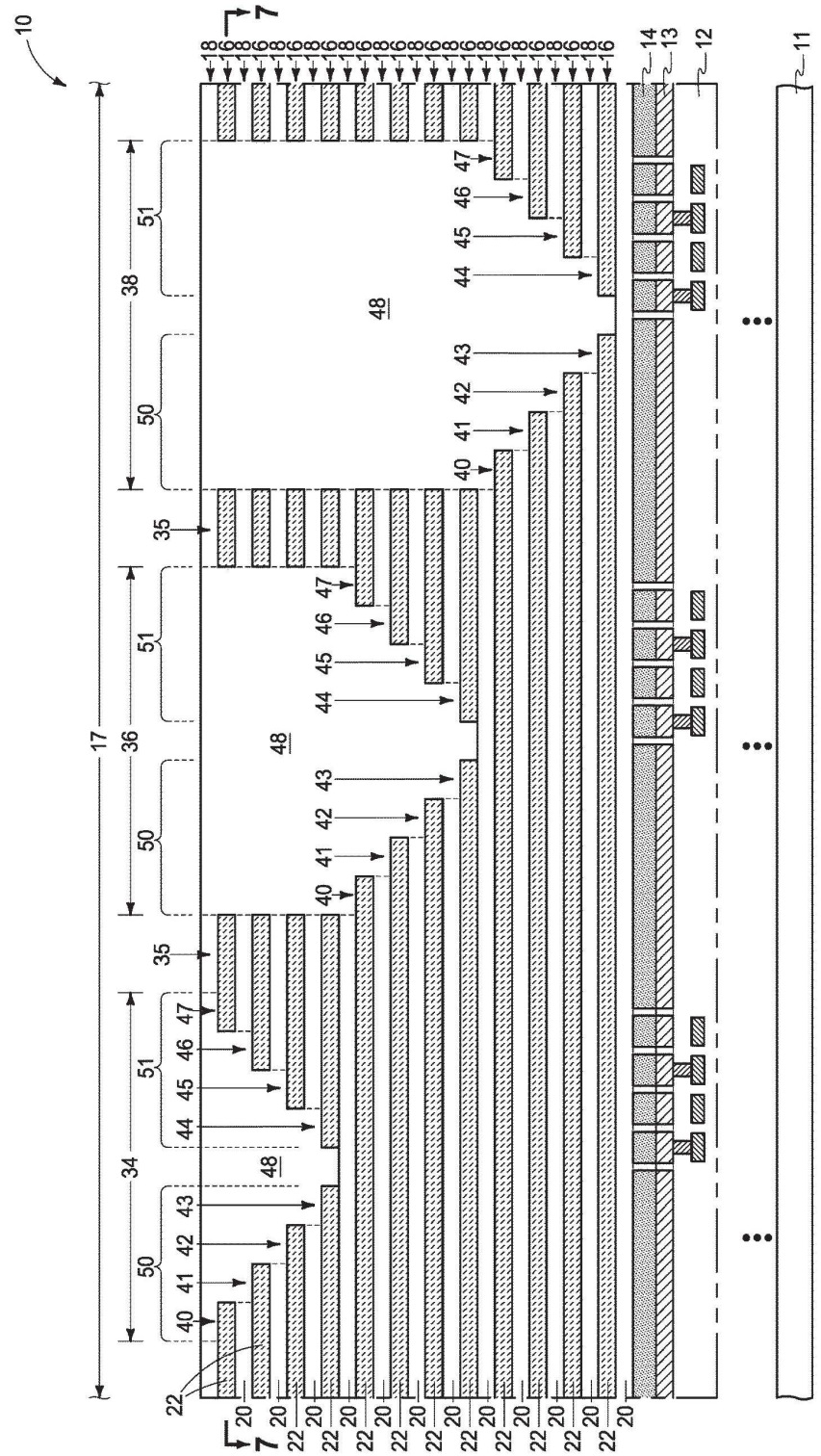
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FIG. 6

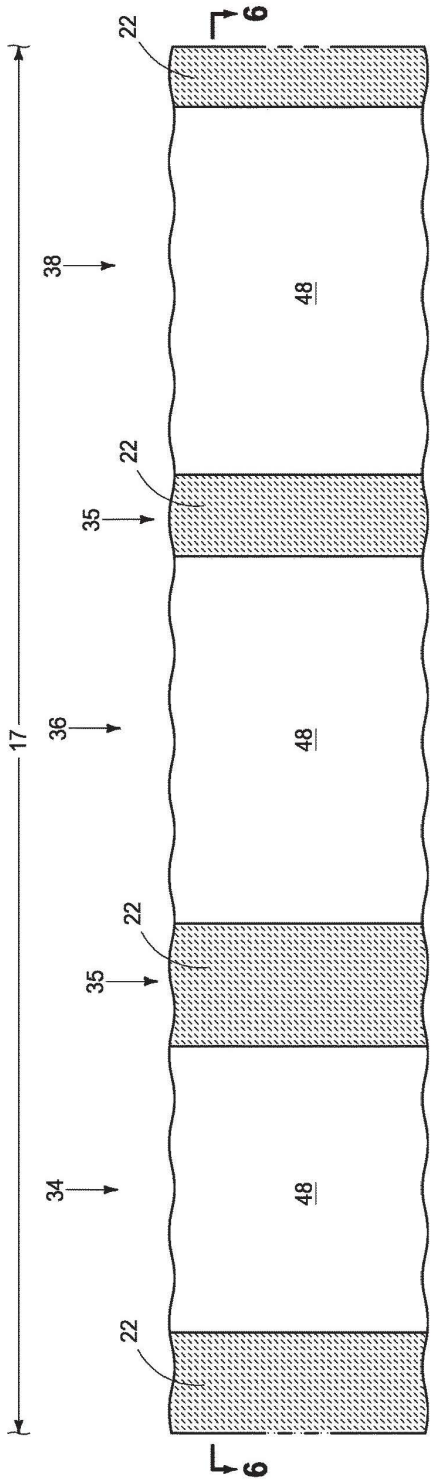

FIG. 7

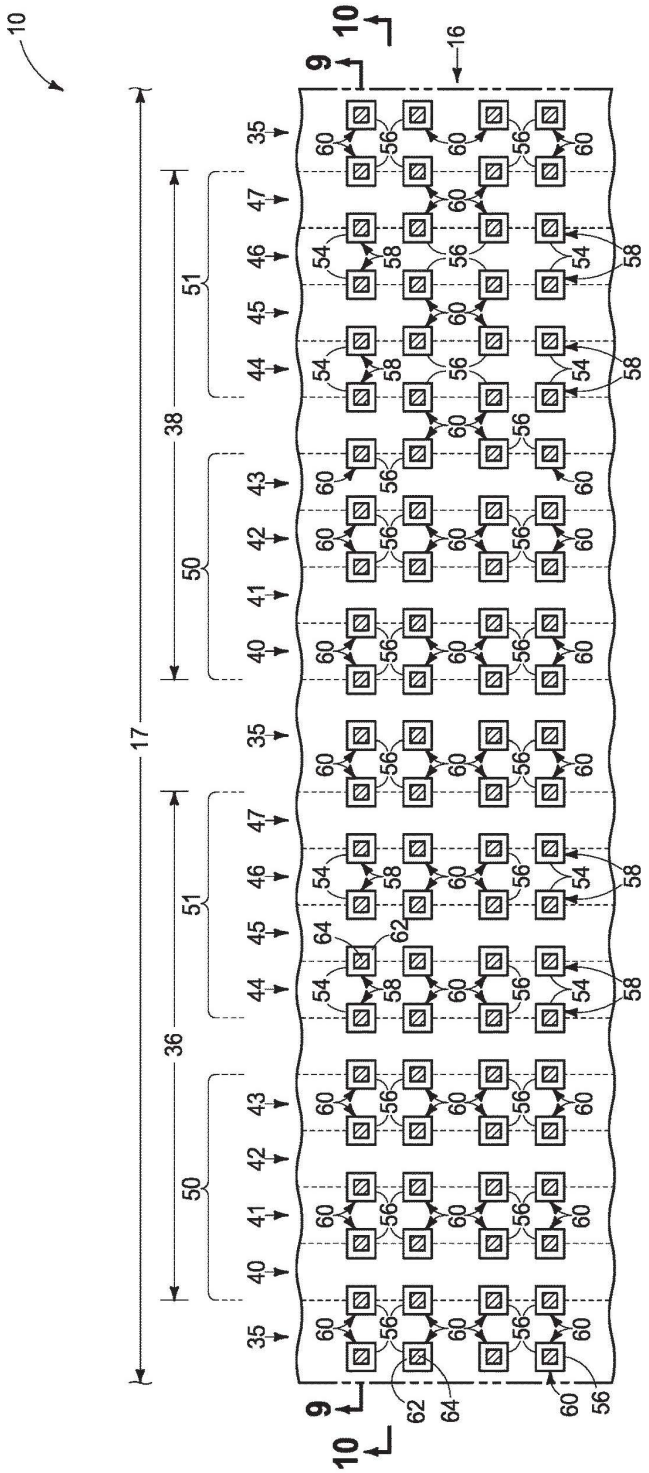

FIG. 8

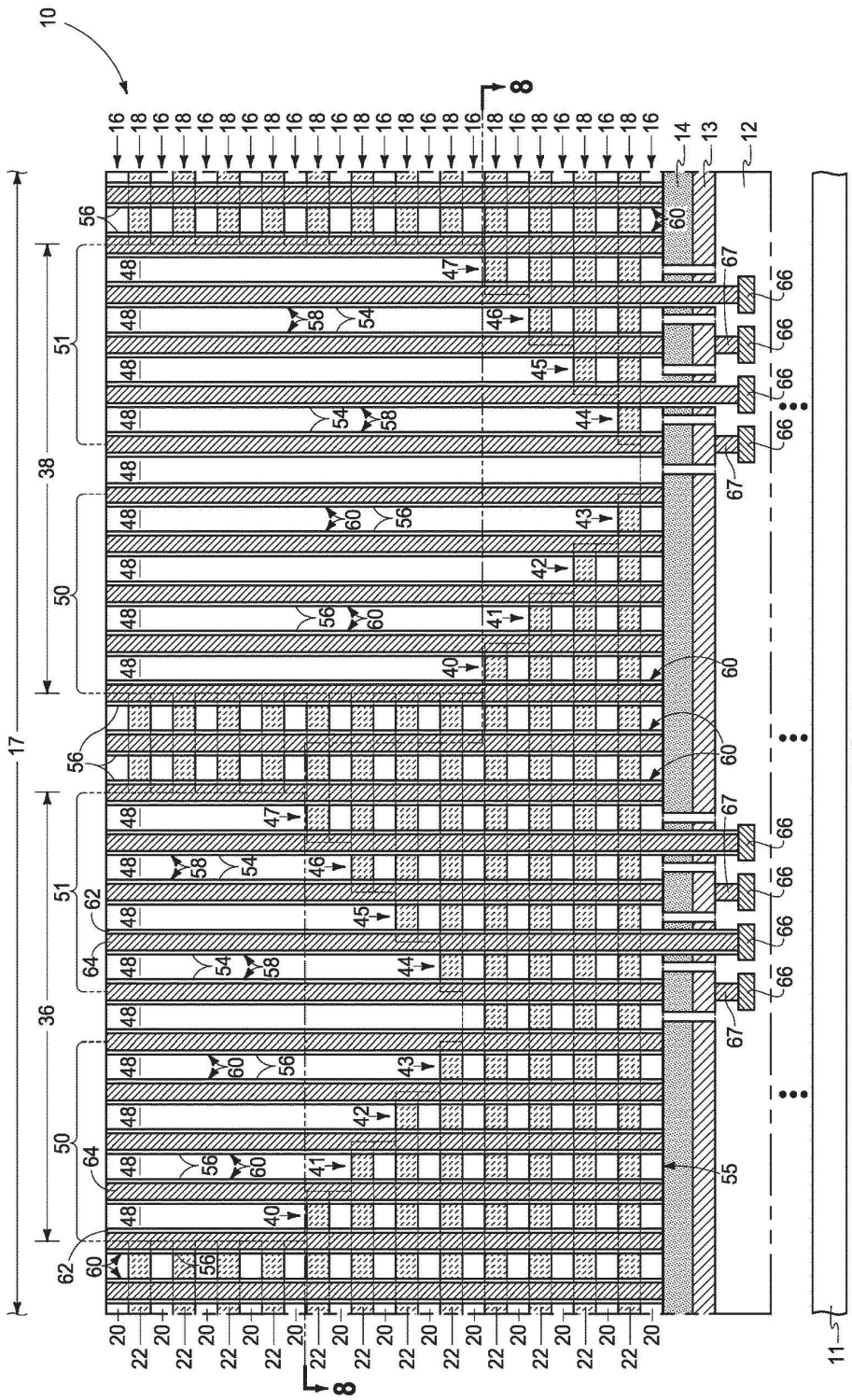
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FIG. 9

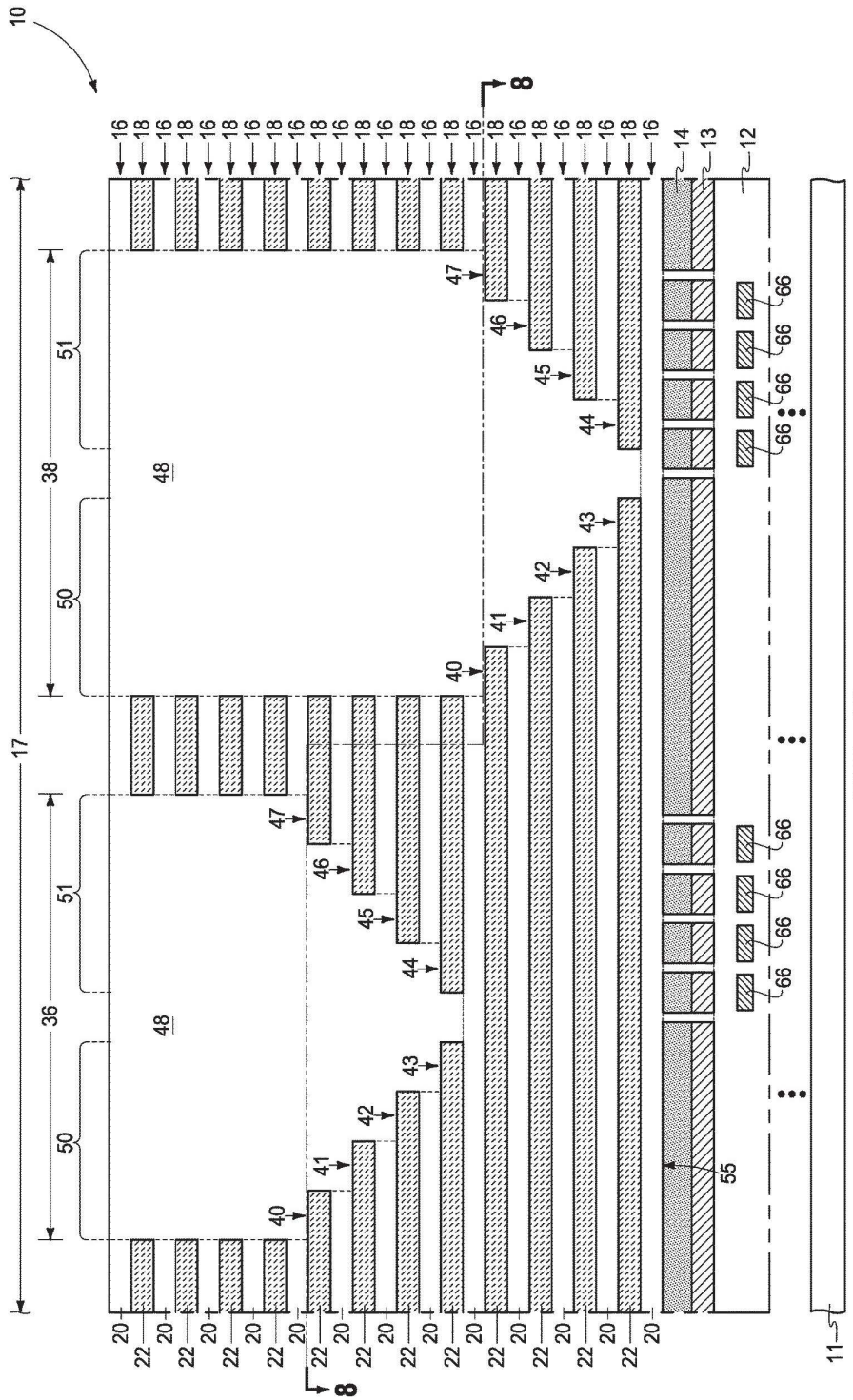
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FIG. 10

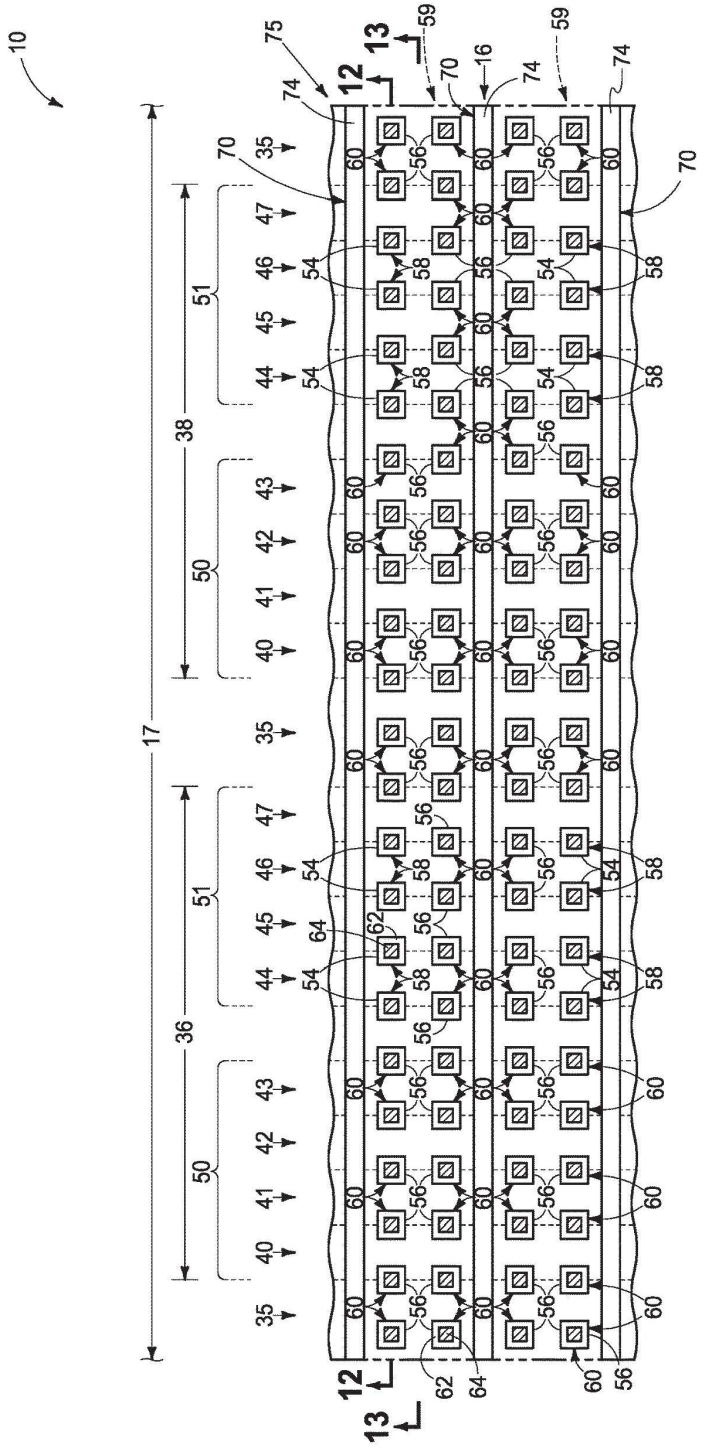
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FIG. 11

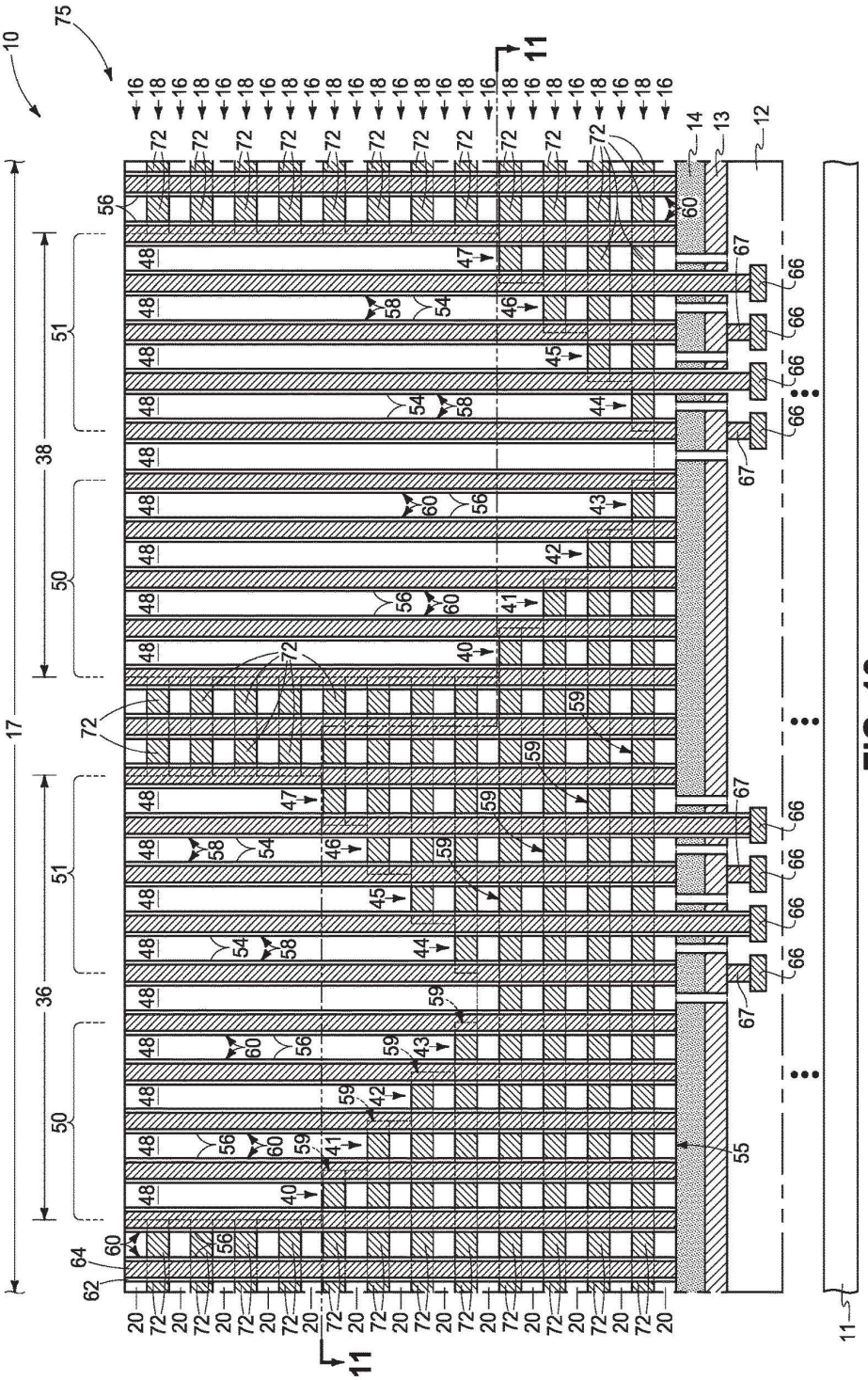

FIG. 12

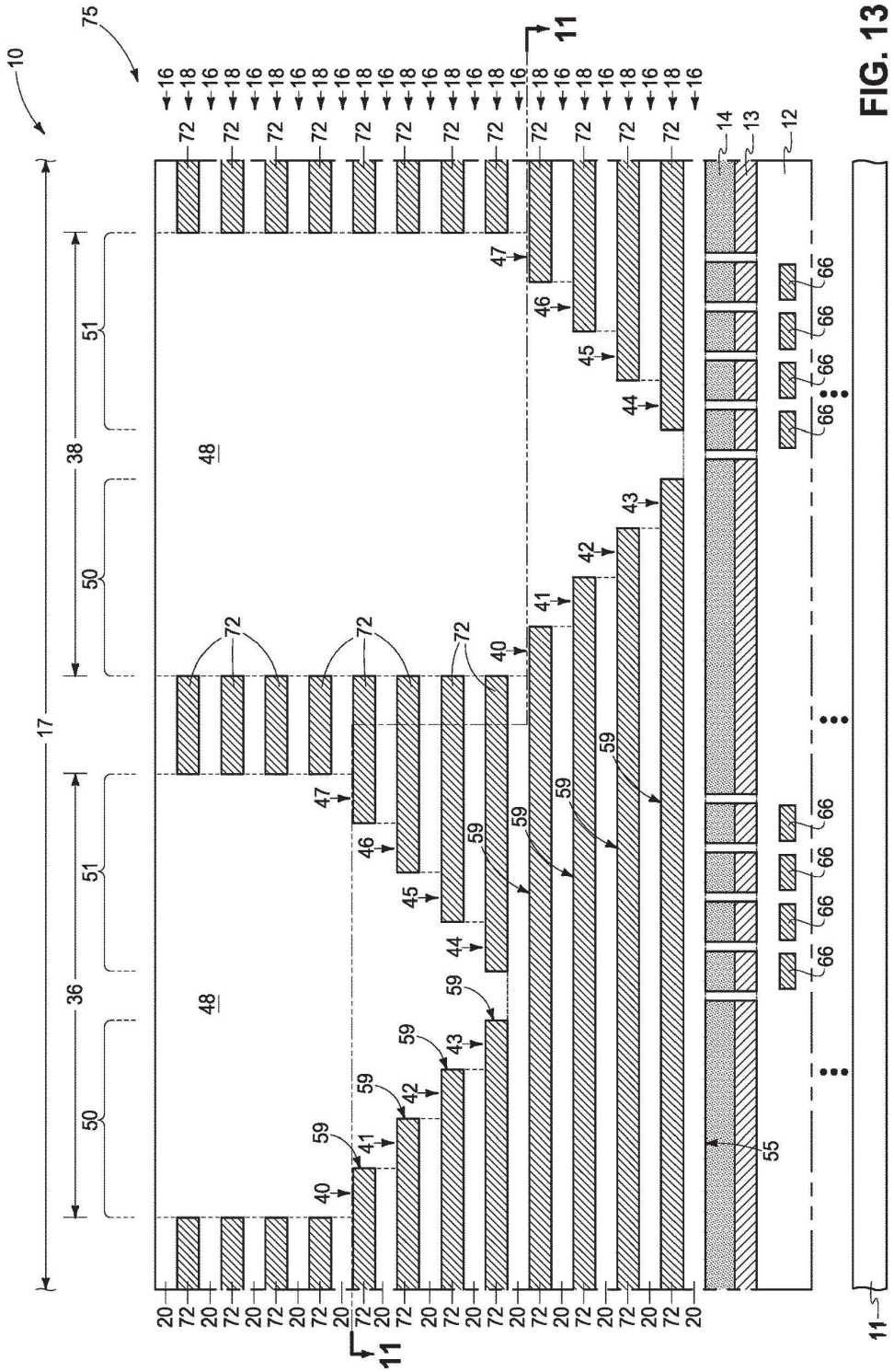
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FIG. 13

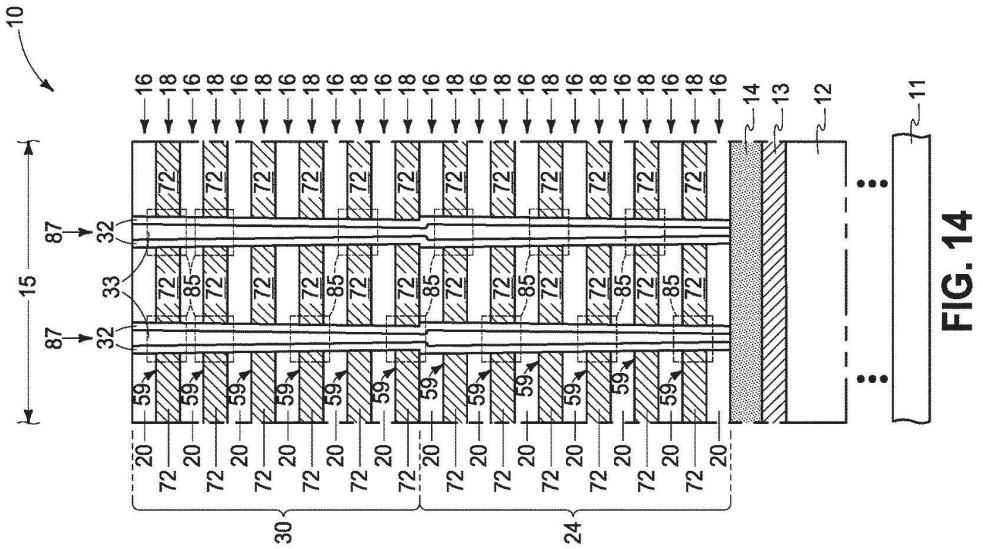

FIG. 14

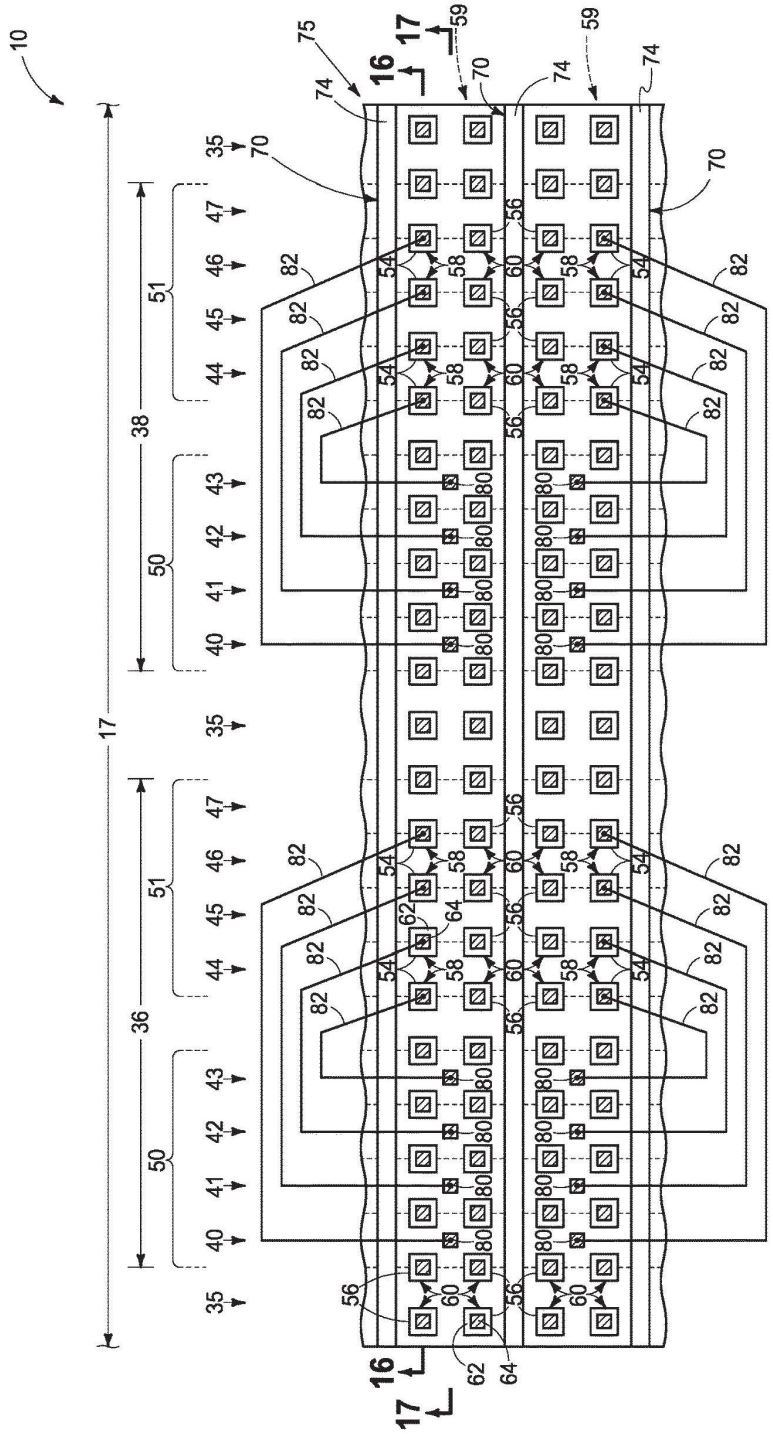
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FIG. 15

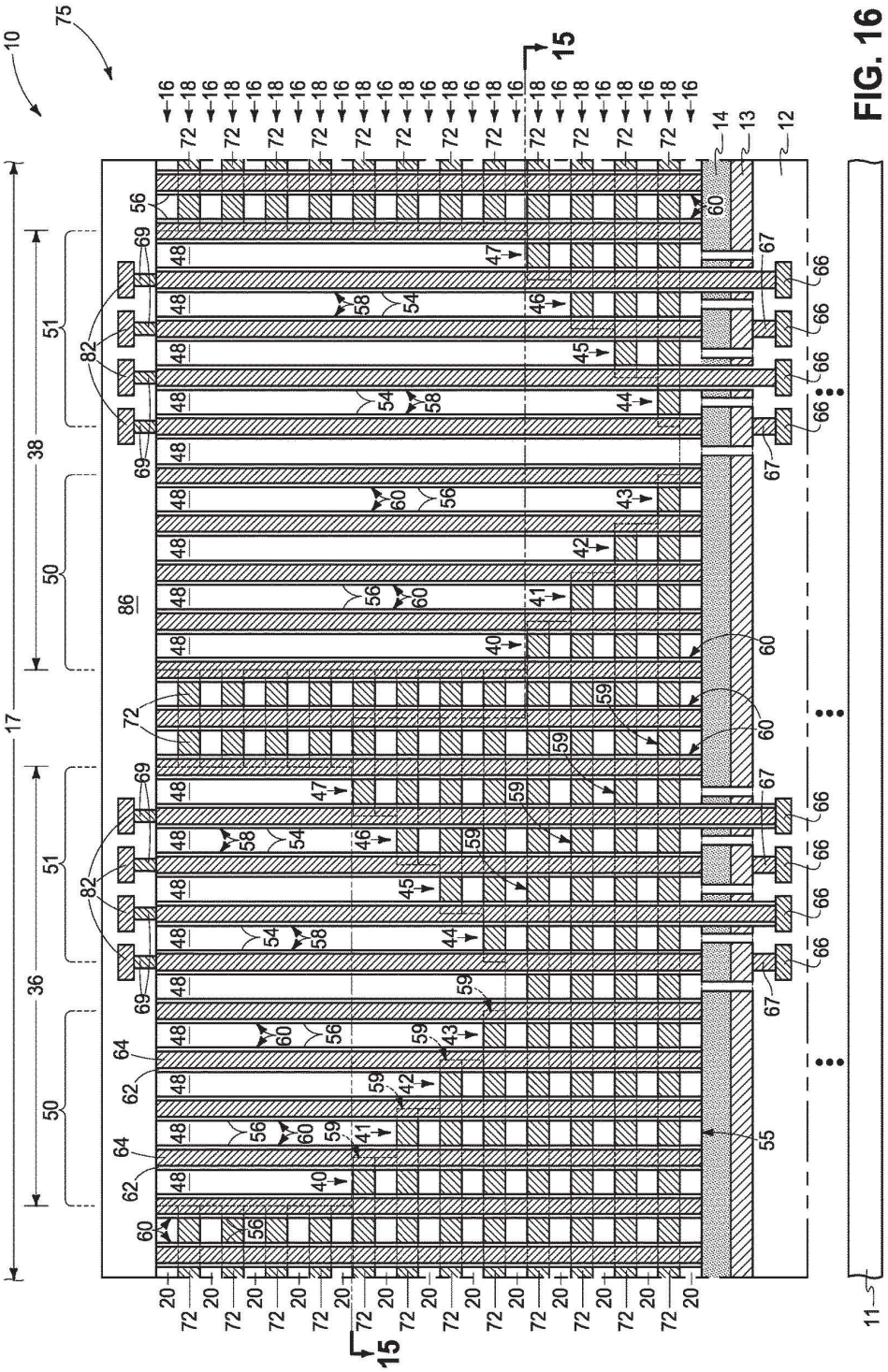
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FIG. 16

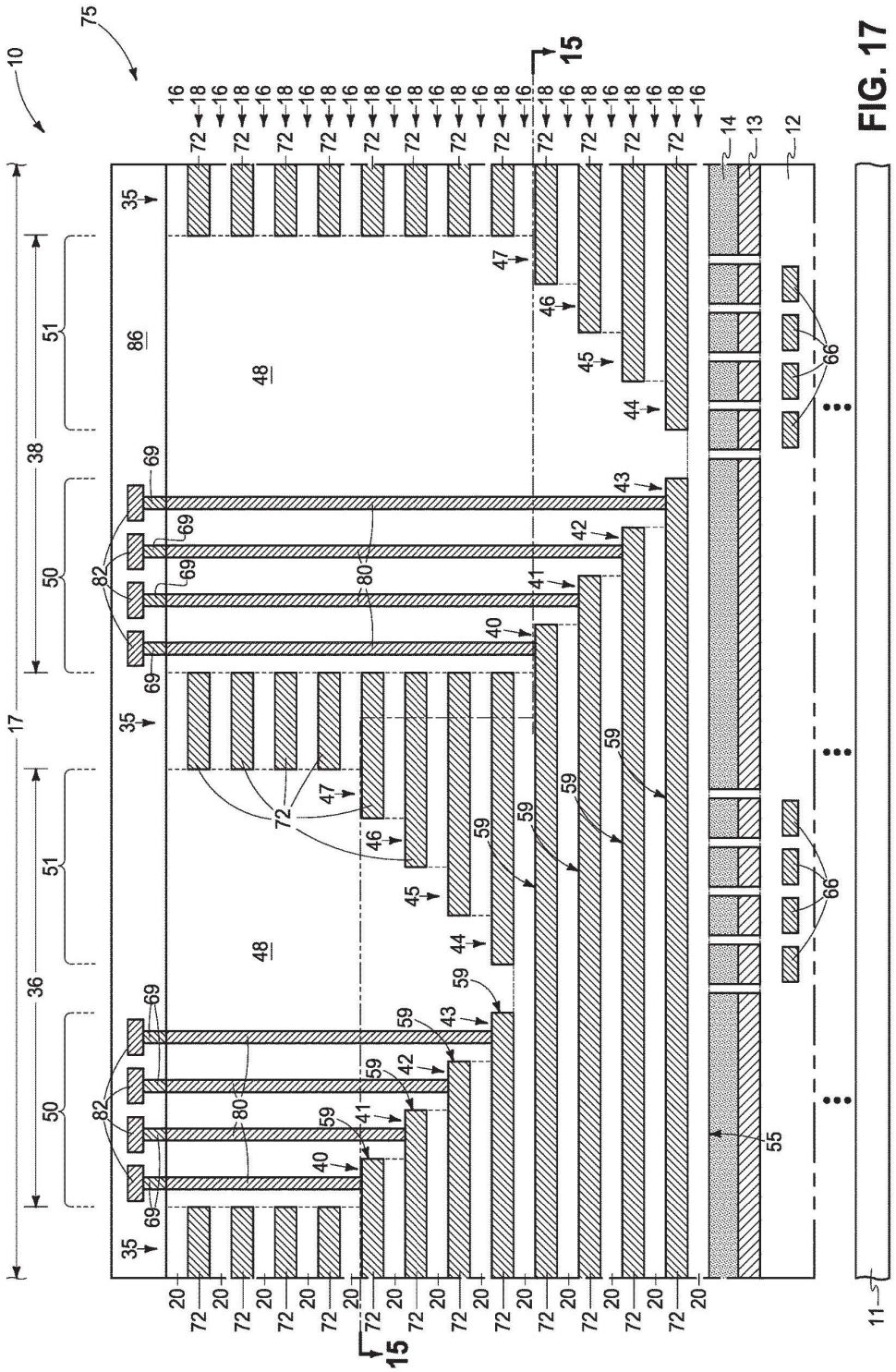
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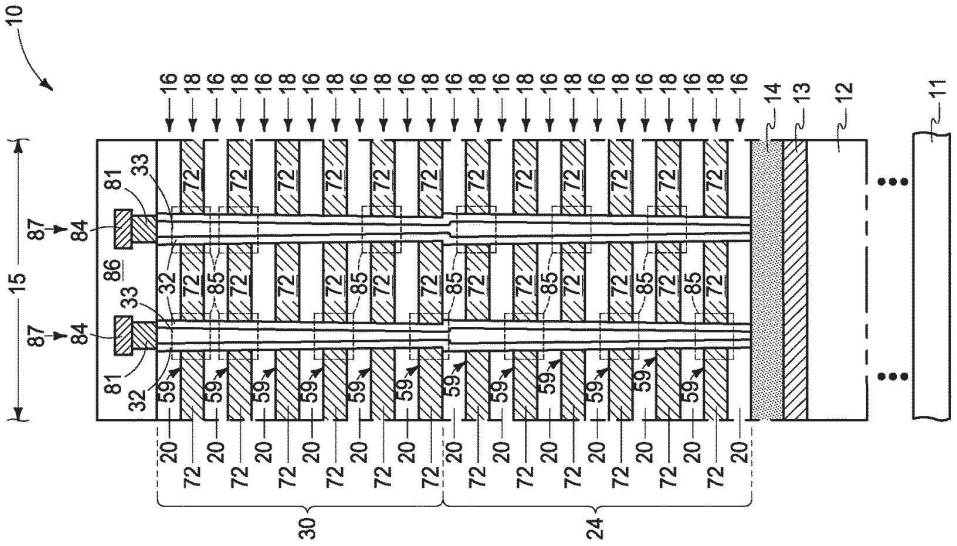
FIG. 17

FIG. 18



DEVICE, A METHOD USED IN FORMING A CIRCUIT STRUCTURE, A METHOD USED IN FORMING AN ARRAY OF ELEVATIONALLY-EXTENDING TRANSISTORS AND A CIRCUIT STRUCTURE ADJACENT THERETO

TECHNICAL FIELD

[0001] Embodiments disclosed herein pertain to devices, to methods used in forming a circuit structure, and to methods used in forming an array of elevationally-extending transistors and a circuit structure adjacent thereto.

BACKGROUND

[0002] Memory is one type of integrated circuitry, and is used in computer systems for storing data. Memory may be fabricated in one or more arrays of individual memory cells. Memory cells may be written to, or read from, using digit lines (which may also be referred to as bit lines, data lines, or sense lines) and access lines (which may also be referred to as word lines). The sense lines may conductively interconnect memory cells along columns of the array, and the access lines may conductively interconnect memory cells along rows of the array. Each memory cell may be uniquely addressed through the combination of a sense line and an access line.

[0003] Memory cells may be volatile, semi-volatile, or non-volatile. Non-volatile memory cells can store data for extended periods of time in the absence of power. Non-volatile memory is conventionally specified to be memory having a retention time of at least about 10 years. Volatile memory dissipates, and is therefore refreshed/rewritten to maintain data storage. Volatile memory may have a retention time of milliseconds or less. Regardless, memory cells are configured to retain or store memory in at least two different selectable states. In a binary system, the states are considered as either a "0" or a "1". In other systems, at least some individual memory cells may be configured to store more than two levels or states of information.

[0004] A field effect transistor is one type of electronic component that may be used in a memory cell. These transistors comprise a pair of conductive source/drain regions having a semiconductive channel region there-between. A conductive gate is adjacent the channel region and separated there-from by a thin gate insulator. Application of a suitable voltage to the gate allows current to flow from one of the source/drain regions to the other through the channel region. When the voltage is removed from the gate, current is largely prevented from flowing through the channel region. Field effect transistors may also include additional structure, for example a reversibly programmable charge-storage region as part of the gate construction between the gate insulator and the conductive gate.

[0005] Flash memory is one type of memory, and has numerous uses in modern computers and devices. For instance, modern personal computers may have BIOS stored on a flash memory chip. As another example, it is becoming increasingly common for computers and other devices to utilize flash memory in solid state drives to replace conventional hard drives. As yet another example, flash memory is popular in wireless electronic devices because it enables manufacturers to support new communication protocols as they become standardized, and to provide the ability to remotely upgrade the devices for enhanced features.

[0006] NAND may be a basic architecture of integrated flash memory. A NAND cell unit comprises at least one selecting device coupled in series to a serial combination of memory cells (with the serial combination commonly being referred to as a NAND string). NAND architecture may be configured in a three-dimensional arrangement comprising vertically-stacked memory cells individually comprising a reversibly programmable vertical transistor.

[0007] Vertical transistors may be formed in arrays not necessarily constituting memory cells.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a diagrammatic cross-sectional view of a portion of a substrate construction in process in accordance with an embodiment of the invention.

[0009] FIG. **2** is a view of the FIG. **1** construction at a processing step subsequent to that shown by FIG. **1**.

[0010] FIG. **3** is a view of the FIG. **2** construction at a processing step subsequent to that shown by FIG. **2**.

[0011] FIG. **4** is a view of the FIG. **3** construction at a processing step subsequent to that shown by FIG. **3**.

[0012] FIG. **5** is a view of the FIG. **4** construction at a processing step subsequent to that shown by FIG. **4**.

[0013] FIG. **6** is a diagrammatic cross-sectional view of a portion of the substrate construction in process in accordance with an embodiment of the invention, and is taken through line **6-6** in FIG. **7**.

[0014] FIG. **7** is a diagrammatic cross-sectional view taken through line **7-7** in FIG. **6**.

[0015] FIG. **8** is a view of a portion of the FIGS. **6** and **7** construction at a processing step subsequent to that shown by FIGS. **6** and **7**, and is taken through line **8-8** in FIGS. **9** and **10**.

[0016] FIG. **9** is a view taken through line **9-9** in FIG. **8**.

[0017] FIG. **10** is a view taken through line **10-10** in FIG. **8**.

[0018] FIG. **11** is a view of the FIG. **8** construction at a processing step subsequent to that shown by FIG. **8**, and is taken through line **11-11** in FIGS. **12** and **13**.

[0019] FIG. **12** is a view taken through line **12-12** in FIG. **11**.

[0020] FIG. **13** is a view taken through line **13-13** in FIG. **11**.

[0021] FIG. **14** is a cross-sectional view of part of the FIG. **1** portion of the substrate construction commensurate in processing with that of FIG. **11**.

[0022] FIG. **15** is a view of the FIG. **11** construction at a processing step subsequent to that shown by FIG. **11**, and is taken through line **15-15** in FIGS. **16** and **17**.

[0023] FIG. **16** is a view taken through line **16-16** in FIG. **15**.

[0024] FIG. **17** is a view taken through line **17-17** in FIG. **15**.

[0025] FIG. **18** is a cross-sectional view of the FIG. **14** portion of the substrate construction commensurate in processing with that of FIG. **15**.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

[0026] Embodiments of the invention encompass devices, methods used in forming a circuit structure, and methods

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used in forming an array of elevationally-extending transistors and a circuit structure adjacent thereto. Method embodiments are initially described with reference to FIGS. **1-18**.

[0027] Referring to FIG. **1**, a construction **10** comprises a base substrate **11** that may include any one or more of conductive/conductor/conducting (i.e., electrically herein), semiconductive/semiconductor/semiconducting, or insulative/insulator/insulating (i.e., electrically herein) materials. Various materials have been formed elevationally over base substrate **11**. Materials may be aside, elevationally inward, or elevationally outward of the FIG. **1**-depicted materials. For example, other partially or wholly fabricated components of integrated circuitry may be provided somewhere above, about, or within base substrate **11**. Control and/or other peripheral circuitry for operating components within an array of transistors may also be fabricated, and may or may not be wholly or partially within a transistor array or sub-array. Further, multiple sub-arrays may also be fabricated and operated independently, in tandem, or otherwise relative one another. As used in this document, a "sub-array" may also be considered as an array. Above base substrate **11** are example substrate material **12** (e.g., insulating material and/or semiconductor material), conductive material **13** (e.g., metal material), and conductively-doped source material **14** (e.g., conductively-doped semiconductor material). Such materials may comprise a portion of circuitry for an array of elevationally-extending transistors being fabricated in accordance with an example embodiment.

[0028] Embodiments of the invention encompass methods used in forming an array of elevationally-extending transistors and a circuit structure adjacent thereto. Some such methods comprise forming vertically-alternating tiers of different composition first and second materials, with the vertically-alternating tiers comprising an array portion and a portion adjacent the array portion. FIG. **1** shows part of an example array portion **15** and part of an example adjacent portion **17**. Some such methods may form only a single stack/deck of such vertically-alternating tiers. Alternately, some such methods may form multiple stacks or decks of such vertically-alternating tiers. The discussion largely proceeds with a fabrication method forming two stacks.

[0029] Vertically-alternating tiers **16** and **18** of different composition first and second materials **20** and **22**, respectively, have been formed relative to or above base substrate **11**. In one embodiment, such may be considered as a first stack **24** of vertically-alternating tiers **16** and **18** of different composition materials one of which (material **22**) comprises first sacrificial material. Construction **10** is shown as having thirteen vertically-alternating tiers **16** and **18** although fewer or likely many more (e.g., dozens, hundreds, etc.) may be formed. Accordingly, more tiers **16** and **18** may be below the depicted tiers and above base substrate **11** and/or more tiers **16** and **18** may be above the depicted tiers. First material **20** comprises insulative material as some or all of such remains in a finished construction of the array and electrically isolates certain features elevationally between different tiers **16**. Second material **22** may be wholly sacrificial, and if so may comprise any one or more of conductive, semiconductive, and insulative materials. One example first material **20** is silicon dioxide, and one example second material **22** is silicon nitride. Such may be formed to be of the same or different thicknesses relative one another, and each need not be of the same respective thickness within the example depicted stack of materials **20**, **22**.

[0030] Elevationally-extending channel openings **26** have been formed into vertically-alternating tiers **16** and **18** in first stack **24**. Example techniques for doing so include photolithographic patterning and etch with or without pitch multiplication. Channel openings **26** may be of any suitable shape in horizontal cross-section (not shown), for example circular, ellipsoidal, square, rectangular, etc. Subsequently, such channel openings are shown as having been filled with second sacrificial material **28** (e.g., any suitable insulative, semiconductive, and/or conductive material that may be etched selectively relative to materials **20** and **22**).

[0031] Referring to FIG. **2**, a second stack **30** of vertically-alternating tiers **18**, **16** of different composition materials **22**, **20** has been formed over first stack **24**, with one of such materials (e.g., material **22**) comprising and/or referred to as third sacrificial material in some embodiments. The third sacrificial material may be of the same composition as or different composition from the first sacrificial material of first stack **24**. As well, material **20** in second stack **30** may be of the same composition as or different composition from that of material **20** in first stack **24**. Ideally, materials **20** and **22** are of the same relative compositions with respect to one another in first stack **24** and second stack **30** as inherently indicated using like numerals **20** and **22** in each stack **24** and **30**, and whereby there is no additional structure or material identifying an interface of first stack **24** with second stack **30**.

[0032] Referring to FIG. **3**, channel openings **26** have been formed into vertically-alternating tiers **16**, **18** in second stack **30** and individually elevationally extend to a different one of channel openings **26** in first stack **24** having second sacrificial material **28** therein. Subsequently, as shown in FIG. **4**, second sacrificial material **28** (not shown) has been removed from channel openings **26** in first stack **24** through channel openings **26** in second stack **30**. Ideally, such is conducted using any suitable wet or dry etch that etches material **28** (not shown) selectively relative to materials **20** and **22**.

[0033] Referring to FIG. **5**, transistor material **32** has been formed in individual channel openings **26** in each of first stack **24** and second stack **30**. Such may comprise, for example and in order of deposition, a charge-blocking material (e.g., silicon dioxide and/or silicon nitride), a charge-storage material (e.g., floating gate material such as doped or undoped silicon, etc. or charge-trapping material such as silicon nitride, metal dots, etc.), a charge-passage material (e.g., a bandgap-engineered structure having nitrogen-containing material such as silicon nitride laterally sandwiched between two insulating oxide layers such as silicon dioxide), and transistor channel material (e.g., suitably doped polysilicon, etc.). Material **22** may be laterally recessed back (not shown) from original channel openings **26** prior to deposition of the example charge-blocking material. Central portions of channel openings **26** may be filled with transistor material (not shown), solid insulator material **33**, or be hollow (not shown).

[0034] A stair step structure is formed which comprises steps individually comprising one of the first sacrificial material or the second sacrificial material above one of the other different composition materials of the first or second stack. FIGS. **6** and **7** show an expanded, yet reduced-scale, version of adjacent portion **17** as comprising three stair step structures **34**, **36**, and **38**, with immediately adjacent of such stair step structures being separated from one another by an

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elevationally-outer landing **35**. Stair step structures **34**, **36**, and **38** individually comprise steps **40**, **41**, **42**, **43**, **44**, **45**, **46**, and **47** comprising example second material **22** above first material **20**. Fewer or more steps may be formed. Additionally, only one stair step structure, two stair step structures, or more than three stair step structures may be formed. Such may be formed by any suitable existing or yet-to-be-developed technique, with photolithographic patterning and etch being one example. An insulating material **48** (e.g., silicon dioxide and/or silicon nitride) is above steps **40-47**.

[0035] In one embodiment and as shown, stair step structures **34**, **36**, and **38** individually comprise opposing first and second sets/flights **50**, **51**, respectively, of steps **40-47**. Alternately, by way of examples only, only one flight of steps may be formed, more than two flights may be formed, and if multiple flights of steps are formed such may not be (not shown) of the same shape, configuration, and/or number of steps relative one another. Regardless, and as shown, stair step structures **34**, **36**, and **38** individually may define a stadium (e.g., a recessed portion) while landings **35** may define a crest between immediately adjacent stadiums.

[0036] The stair step structure(s) may be formed before or after forming channel openings **26** and before or after forming transistor channel material in the individual channel openings.

[0037] The discussion proceeds with reference to stair step structures **36** and **38** which, by way of example only, are subsequently referred to as first stair step structure **36** and adjacent second stair step structure **38**. Referring to FIGS. **8-10**, elevationally-extending dummy-structure openings **56** have been formed through insulating material **48** and vertically-alternating tiers **16** and **18** in adjacent portion **17**. Dummy-structure openings **56** individually extend elevationally through one of steps **40-47** at least to a bottom **55** of vertically-alternating tiers **16**, **18**. Elevationally-extending via openings **54** have also been formed through insulating material **48** and vertically-alternating tiers **16**, **18** in adjacent portion **17**. Via openings **54** individually extend elevationally through one of steps **40-47** at least to bottom **55** of vertically-alternating tiers **16**, **18**. In one embodiment, dummy-structure openings **56** and via openings **54** are formed at the same time (i.e., simultaneously). Regardless, in one embodiment, dummy-structure openings **56** and via openings **54** are formed using a single masking step (e.g., using masking material [not shown] formed atop structure **10**). In one embodiment, dummy-structure openings **56** and via openings **54** are formed to be of the same size and shape relative one another. Openings **54** and **56** are shown as being collectively arrayed in straight-line rows and columns. However, any alternate configuration may be used including, for example, staggering (not shown) alternating openings **54**/**56** in rows and/or columns.

[0038] Operative conductive vias **58** have been formed within via openings **54**, thereby individually extending elevationally through insulating material **48**, through one of steps **40-47**, and through vertically-alternating tiers **16**, **18** of first and second stacks **24**, **30**, respectively, at least to bottom **55** of vertically-alternating tiers **16**, **18**. Dummy structures **60** have been formed within dummy openings **56**, thereby also individually extending elevationally through insulating material **48**, through vertically-alternating tiers **16**, **18**, and through one of steps **40-47** at least to bottom **55** of vertically-alternating tiers **16**, **18**. In one embodiment, operative conductive vias **58** and dummy structures **60** are formed at the same time. In one embodiment and as shown, dummy structures **60** and operative conductive vias **58** are formed to comprise an insulative lining **62** (e.g., silicon dioxide and/or silicon nitride) and a conductive core **64** (e.g., metal material). In one embodiment, insulative linings **62** and conductive cores **64** in dummy-structure openings **56** and in via openings **54** are formed at the same time.

[0039] The operative conductive vias individually electrically couple to an electronic component that is below the vertically-alternating tiers. By way of example only, conductive lines **66** (example electronic components) are shown below conductive material **13**, with each example operative conductive via **58** being electrically coupled to one of lines **66**. For example. and by way of example only, FIG. **9** shows some alternate ones of operative conductive vias **58** directly electrically coupling to individual conductive lines **66** through source material **14**, conductive material **13**, and conductive vias **67**. Another some alternate ones of operative conductive vias **58** directly electrically couple to individual conductive lines **66** by extending completely through materials **14** and **13** to be directly against individual conductive lines **66**. The depicted features comprising materials **14**, **13**, **67**, and **66** may comprise portions of respective pass transistors or other devices, and by way of examples only.

[0040] After forming dummy structures **60** and operative conductive vias **58**, at least a majority of second material **22**, in one embodiment all of second material **22**, is etched away from the respective stair step structures. In one embodiment, at least a majority of second material **22**, in one embodiment all of second material **22**, is replaced with conductive material (e.g., whereby stair step structure **17** is fully metallized).

[0041] For example in the depicted embodiment, and referring to FIGS. **11-13**, horizontally-elongated trenches **70** (e.g., stack slots) have been formed to extend elevationally into vertically-alternating tiers **16**, **18**. Thereafter, an etchant has been flowed through trenches **70** to second material **22** (not shown) to etch away at least a majority thereof from stair step structures **36**, **38**. Such may thereby temporarily effectively leave void space (not shown) elevationally between first material tiers **20**, with such tiers being elevationally supported and prevented from collapsing within array portion **15** by transistor material **32** and by both dummy-support structures **60** and operative conductive vias **58** within the stair step structures in adjacent portion **17**. FIGS. **11-13** show the void space (not shown) resulting from etching away material **22** (not shown) as having been filled with conductive material **72** (e.g., metal material). Steps **40-47** now comprise conductive steps due to presence of conductive material **72** and that are at least partially elevationally separated from one another by insulative material **20**.

[0042] FIG. **14** analogously shows replacement of second material **22** (not shown) with conductive material **72** in array portion **15**. Such has formed individual elevationally-extending transistors **85** (e.g., memory cells **85**), for example within strings **87** individually shown as having twelve transistors **85**.

[0043] Still referring to FIGS. **11-13**, conductive material **72** would also likely fill (not shown) trenches **70** in array portion **15** (and in adjacent portion **17**). Conductive material **72** could then be anisotropically etched from trenches **70**. Then, trenches **70** have been filled with dielectric material **74**. Accordingly, and by way of example only in one

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embodiment, horizontally-elongated trenches **70** form longitudinal outlines of access lines **59** extending from array portion **15** into adjacent portion **17** to individual steps **40-43** of flights **50**. Access lines **59** may be of alternate width and/or shape in array portion **15** compared to adjacent portion **17** (not shown). Regardless, the depicted adjacent/staircase portion **17** may be considered as comprising a circuit structure **75** (i.e., an assemblage of electronic components) that is adjacent and electrically coupled to elevationally-extending transistors **85** of array portion **15**.

[0044] The above-described processing may be termed by people of skill in the art as "replacement gate" and/or "gate-last" processing. Regardless, trenches **70** may be longitudinally continuous or longitudinally discontinuous (not shown), may comprise conductive material therein (not shown), may extend elevationally through all of tiers **16** and **18**, may extend elevationally through only some of tiers **16** and **18**, etc.

[0045] One or more of the stair step structures (e.g., stair step structure **34** in FIGS. **6** and **7**) may comprise select gates (e.g., separate from access lines **59** and not shown). For example, stair step structure **34** may be configured as a select gate drain (SGD) structure for communicating with transistors **85** and may be coupled by select gates of a SGD control unit below tiers **16** and **18** in adjacent portion **17**. Such a SGD structure may be separate from all other stair step structures, or formed as a portion (e.g., an upper portion) of one stair step structure. For example, the uppermost steps of the stair step structure closest to array portion **15** (e.g., steps **40+** in flight **50** of structure **34**) may comprise landing pads of an SGD structure where remaining steps act as landing pads for differing electrical connections (e.g. contact portions/steps for access lines).

[0046] Referring to FIGS. **15-18**, and in one embodiment, operating conducting vias **80** have been formed which individually extend elevationally to and directly electrically couple with conductive material **72** of one of conductive steps **40-47**. Interconnect lines **82** have been formed above stair step structures **36** and **38** and individually directly electrically couple together different individual operating conducting vias **80** to different individual operative conductive vias **58** through conductive extensions **69**. Interconnect lines **82** are shown schematically in FIG. **15**. Strings **87** of transistors **85** may connect with individual conductive lines **84** through conductive extensions **81**. Insulator material **86** (e.g., silicon nitride and/or silicon dioxide) is shown surrounding components **69**, **82**, **81**, and **84**.

[0047] Embodiments of the invention also encompass devices independent of method of manufacture. However, any of the structural attributes described above with respect to method embodiments may be found in structural aspects of the invention and vice versa.

[0048] An embodiment of the invention includes a device comprising an array (e.g., **15**) of elevationally-extending transistors (e.g., **85**). Such a device also comprises a circuit structure (e.g., **75**) adjacent and electrically coupled to the elevationally-extending transistors of the array. The circuit structure comprises a stair step structure (e.g., any of **34**, **36**, and **38**) comprising vertically-alternating tiers (e.g., **16**, **18**) comprising conductive steps (e.g., **40-47** in FIGS. **16** and **17**) that are at least partially elevationally separated from one another by insulative material (e.g., **20**). Operative conductive vias (e.g., **58**) individually extend elevationally through one of the conductive steps at least to a bottom (e.g., **55**) of the vertically-alternating tiers and which individually electrically couple to an electronic component (e.g., one or more of **14**, **13**, and **66**) below the vertically-alternating tiers. Dummy structures (e.g., **60**) individually extend elevationally through one of the conductive steps at least to the bottom of the vertically-alternating tiers.

[0049] The dummy structures may individually be conductive top-to-bottom through the vertically-alternating tiers. The operative conductive vias and the dummy structures may individually be of the same peripheral size and peripheral shape. The operative conductive vias and the dummy structures may individual comprise a conductive core (e.g., **64**) and an insulative periphery (e.g., **62**). The conductive cores and the insulative peripheries in the operative conductive vias and the dummy structures may individually extend at least top-to-bottom through the vertically-alternating tiers.

[0050] The operative conductive vias may individually extend elevationally through more than one of the conductive steps. In one such embodiment, the operative conductive vias may individually extend elevationally through multiple of the conductive steps, in one such embodiment through no more than two of the conductive steps, and in one such embodiment individually extend elevationally through equal surface areas of the two conductive steps through which the operative conductive vias elevationally extend. For example, and by way of example only, the operative conductive vias in FIGS. **15-17** individually overlap two immediately-adjacent steps and extend through equal surface areas of each such step.

[0051] The dummy structures may individually extend elevationally through more than one of the conductive steps. In one such embodiment, the dummy structures may individually extend elevationally through multiple of the conductive steps, in one such embodiment through no more than two of the conductive steps, and in one such embodiment individually extend elevationally through equal surface areas of the two conductive steps through which the dummy structures elevationally extend. For example, and by way of example only, the dummy structures in FIGS. **15-17** individually overlap two immediately-adjacent steps and extend through equal surface areas of each such step.

[0052] In one embodiment, operating conducting vias (e.g., **80**) individually extend elevationally to and directly electrically couple with conductive material (e.g., **72**) of one of the conductive steps. Individual of the operative conducting vias and individual of the operative conductive vias are directly electrically coupled to one another by an interconnect line (e.g., **82**) that is above the stair step structure.

[0053] In one embodiment, one of the operative conductive vias and one of the dummy structures are side-by-side and extend elevationally through the same one of the conductive steps, and in one such embodiment, the one operative conductive via and the one dummy structure also extend elevationally through another same one of the conductive steps. For example, and by way of example only, an operative conductive via **58** and a dummy structure **60** are side-by-side in an access line **59** with respect to steps **46** and **47** and satisfy such criteria.

[0054] In one embodiment, one of the conductive steps (e.g., any of **40**, **41**, **42**, or **43**) comprises conductive material that extends into the array and which electrically couples to some of the transistors in the array. Another of the conductive steps (e.g., any of **44**, **45**, **46**, or **47**) comprises conduc-

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tive material that does not extend into the array and which does not electrically couple to any transistor in the array.

[0055] Any other attribute(s) or aspect(s) as shown and/or described herein with respect to other embodiments may be used.

[0056] In one embodiment, a device comprises an array of elevationally-extending transistors and a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array. The circuit structure comprises a first stair step structure (e.g., **36**) and an adjacent second stair step structure (e.g., **38**) individually comprising vertically-alternating tiers comprising first and second opposing flights (e.g., **50**, **51**) of conductive steps. The conductive steps are at least partially elevationally separated from one another by insulative material in each of the first and second stair step structures. An elevationally-outer landing (e.g., **35**) is between the first stair step structure and the second stair step structure. Operative conductive vias are in each of the first and second stair step structures, and individually extend elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers of the respective first or second stair step structure. The operative conductive vias individually electrically couple to an electronic component below the vertically-alternating tiers of the respective first or second stair step structures. First dummy structures (e.g., certain structures **60**) are in each of the first and second stair step structures, and individually extend elevationally through one of the conductive steps at least to the bottom of the vertically-alternating tiers of the respective first or second stair step structure. A second dummy structure (e.g., certain of structures **60**) extends elevationally through the landing. Any other attribute(s) or aspect(s) as shown and/or described herein with respect to other embodiments may be used.

[0057] In one embodiment, a device comprises an array of elevationally-extending transistors and a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array. The circuit structure comprises a stair step structure comprising vertically-alternating tiers comprising first and second opposing flights of conductive steps. The conductive steps are at least partially elevationally separated from one another by insulative material. Operative conductive vias individually extend elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers. The operative conductive vias individually electrically couple to an electronic component below the vertically-alternating tiers. First-flight-dummy structures (e.g., **60** in a flight **50**) individually extend elevationally through one of the first-flight conductive steps (e.g., any of **40**, **41**, **42**, or **43**) at least to the bottom of the vertically-alternating tiers. Second-flight-dummy structures (e.g., **60** in a flight **51**) individually extend elevationally through one of the second-flight conductive steps (e.g., any of **44**, **45**, **46**, or **47**) at least to the bottom of the vertically-alternating tiers. In one embodiment, the first and second flights have the same total number of steps. In one embodiment, the operative conductive vias extend elevationally only through the steps in one of the first or second flights and not in the other of the first and second flights. Any other attribute(s) or aspect(s) as shown and/or described herein with respect to other embodiments may be used.

[0058] In one embodiment, a device comprises an array of elevationally-extending transistors and a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array. The circuit structure comprises a first stair step structure and an adjacent second stair step structure individually comprising vertically-alternating tiers comprising first and second opposing flights of conductive steps. The conductive steps are at least partially elevationally separated from one another by insulative material in each of the first and second stair step structures. Operative conductive vias are in each of the first and second stair step structures, and individually extend elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers of the respective first or second stair step structure. The operative conductive vias individually electrically couple to an electronic component below the vertically-alternating tiers of the respective first or second stair step structure. First-flight-dummy structures are in each of the first and second stair step structures and individually extend elevationally through one of the first-flight conductive steps in the respective first or second stair step structures at least to the bottom of the vertically-alternating tiers of the respective first or second stair step structures. Second-flight-dummy structures are in each of the first and second stair step structures, and individually extend elevationally through one of the second-flight conductive steps in the respective first or second stair step structure at least to the bottom of the vertically-alternating tiers of the respective first and second stair step structure. Any other attribute(s) or aspect(s) as shown and/or described herein with respect to other embodiments may be used.

[0059] In some embodiments, any one or more of the elevationally-extending features is formed to be vertical or within 10° of vertical.

[0060] Any of the attributes as disclosed in U.S. Pat. No. 9,589,978 and/or in U.S. patent application Ser. No. 15/068,329 filed Mar. 11, 2016 may be used.

[0061] In this document unless otherwise indicated, "elevational", "higher", "upper", "lower", "top", "atop", "bottom", "above", "below", "under", "beneath", "up", and "down" are generally with reference to the vertical direction. "Horizontal" refers to a general direction (i.e., within 10 degrees) along a primary substrate surface and may be relative to which the substrate is processed during fabrication, and vertical is a direction generally orthogonal thereto. Reference to "exactly horizontal" is the direction along the primary substrate surface (i.e., no degrees there-from) and may be relative to which the substrate is processed during fabrication. Further, "vertical" and "horizontal" as used herein are generally perpendicular directions relative one another and independent of orientation of the substrate in three-dimensional space. Additionally, "elevationally-extending" and "extending elevationally" refer to a direction that is angled away by at least 450 from exactly horizontal. Further, "extend(ing) elevationally" and "elevationally-extending" with respect to a field effect transistor are with reference to orientation of the transistor's channel length along which current flows in operation between the source/drain regions. For bipolar junction transistors, "extend(ing) elevationally" and "elevationally-extending" are with reference to orientation of the base length along which current flows in operation between the emitter and collector.

[0062] Further, "directly above" and "directly under" require at least some lateral overlap (i.e., horizontally) of two stated regions/materials/components relative one another. Also, use of "above" not preceded by "directly"

only requires that some portion of the stated region/material/component that is above the other be elevationally outward of the other (i.e., independent of whether there is any lateral overlap of the two stated regions/materials/components). Analogously, use of "under" not preceded by "directly" only requires that some portion of the stated region/material/component that is under the other be elevationally inward of the other (i.e., independent of whether there is any lateral overlap of the two stated regions/materials/components).

[0063] Any of the materials, regions, and structures described herein may be homogenous or non-homogenous, and regardless may be continuous or discontinuous over any material which such overlie. Further, unless otherwise stated, each material may be formed using any suitable or yet-to-be-developed technique, with atomic layer deposition, chemical vapor deposition, physical vapor deposition, epitaxial growth, diffusion doping, and ion implanting being examples.

[0064] Additionally, "thickness" by itself (no preceding directional adjective) is defined as the mean straight-line distance through a given material or region perpendicularly from a closest surface of an immediately-adjacent material of different composition or of an immediately-adjacent region. Additionally, the various materials or regions described herein may be of substantially constant thickness or of variable thicknesses. If of variable thickness, thickness refers to average thickness unless otherwise indicated, and such material or region will have some minimum thickness and some maximum thickness due to the thickness being variable. As used herein, "different composition" only requires those portions of two stated materials or regions that may be directly against one another to be chemically and/or physically different, for example if such materials or regions are not homogenous. If the two stated materials or regions are not directly against one another, "different composition" only requires that those portions of the two stated materials or regions that are closest to one another be chemically and/or physically different if such materials or regions are not homogenous. In this document, a material, region, or structure is "directly against" another when there is at least some physical touching contact of the stated materials, regions, or structures relative one another. In contrast, "over", "on", "adjacent", "along", and "against" not preceded by "directly" encompass "directly against" as well as construction where intervening material(s), region (s), or structure(s) result(s) in no physical touching contact of the stated materials, regions, or structures relative one another.

[0065] Herein, regions-materials-components are "electrically coupled" relative one another if in normal operation electric current is capable of continuously flowing from one to the other, and does so predominately by movement of subatomic positive and/or negative charges when such are sufficiently generated. Another electronic component may be between and electrically coupled to the regions-materials-components. In contrast, when regions-materials-components are referred to as being "directly electrically coupled", no intervening electronic component (e.g., no diode, transistor, resistor, transducer, switch, fuse, etc.) is between the directly electrically coupled regions-materials-components.

[0066] Additionally, "metal material" is any one or combination of an elemental metal, a mixture or an alloy of two or more elemental metals, and any conductive metal compound.

[0067] In this document, a selective etch or removal is an etch or removal where one material is removed relative to another stated material or materials at a rate of at least 2.0:1.

[0068] In this document, a "dummy structure" refers to a structure which is used to mimic a physical property of another structure (e.g., presence, or physical load-carrying/supporting ability of an operative structure) and which may comprise a circuit inoperable electrical dead end (e.g., is not part of a current flow path of a circuit even if conductive). Openings in which dummy structures are formed may be considered as "dummy-structure openings".

[0069] In compliance with the statute, the subject matter disclosed herein has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the claims are not limited to the specific features shown and described, since the means herein disclosed comprise example embodiments. The claims are thus to be afforded full scope as literally worded, and to be appropriately interpreted in accordance with the doctrine of equivalents.

1. A method used in forming a circuit structure, comprising:

forming vertically-alternating tiers of different composition first and second materials;

forming a stair step structure comprising steps individually comprising the second material above the first material, the stair step structure comprising insulating material above the steps;

forming operative conductive vias individually extending elevationally through the insulating material, through one of the steps, and through the vertically-alternating tiers at least to a bottom of the vertically-alternating tiers; the operative conductive vias individually electrically coupling to an electronic component below the vertically-alternating tiers;

forming dummy structures individually extending elevationally through the insulating material, through the vertically-alternating tiers, and through one of the steps at least to the bottom of the vertically-alternating tiers; and

after forming the dummy structures and the operative conductive vias, etching away at least a majority of the second material from the stair step structure.

2. The method of claim **1** comprising forming the operative conductive vias and the dummy structures at the same time.

3. The method of claim **1** wherein the etching etches away all of the second material from the stair step structure.

4. The method of claim **1** comprising forming horizontally-elongated trenches extending elevationally into the vertically-alternating tiers before the etching, the etching comprising flowing an etchant through the trenches to the second material.

5. The method of claim **1** comprising forming the stair step structure to comprise opposing first and second sets of the steps.

6. The method of claim **1** comprising forming multiple of the stair step structures with immediately adjacent of the stair step structures being separated from one another by an elevationally-outer landing.

7. The method of claim **1** comprising:

forming operative conducting vias individually extending elevationally to and directly electrically coupling with conductive material of one of the conductive steps; and

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forming interconnect lines above the stair step structure that individually directly electrically couple together different individual of the operative conducting vias and different individual of the operative conductive vias.

8. A method used in forming an array of elevationally-extending transistors and a circuit structure adjacent thereto, comprising:

forming vertically-alternating tiers of different composition first and second materials, the vertically-alternating tiers comprising an array portion and a portion adjacent the array portion;

forming elevationally-extending channel openings into the vertically-alternating tiers in the array portion and forming transistor channel material in individual of the channel openings;

forming a stair step structure comprising steps individually comprising the second material above the first material, the stair step structure comprising insulating material above the steps;

forming elevationally-extending dummy-structure openings through the insulating material and the vertically-alternating tiers in the adjacent portion, the dummy-structure openings individually extending elevationally through one of the steps at least to a bottom of the vertically-alternating tiers;

forming elevationally-extending via openings through the insulating material and the vertically-alternating tiers in the adjacent portion, the via openings individually extending elevationally through one of the steps at least to the bottom of the vertically-alternating tiers;

forming an insulative lining and a conductive core in individual of the dummy-structure openings to form dummy structures and in individual of the conductive via openings to form operative conductive vias which individually electrically couple to an electronic component below the vertically-alternating tiers; and

after forming the dummy structures and the operative conductive vias, replacing at least a majority of the second material with conductive material.

9. The method of claim **8** comprising forming the stair step structure before forming the channel openings.

10. The method of claim **8** comprising forming the stair step structure after forming the channel openings.

11. The method of claim **8** comprising forming the dummy-structure openings and the via openings at the same time.

12. The method of claim **11** comprising forming the insulative linings and the conductive cores in the dummy-structure openings and in the conductive via openings at the same time.

13. The method of claim **8** comprising forming the dummy-structure openings and the via openings using a single masking step.

14. The method of claim **8** comprising forming the insulative linings and the conductive cores in the dummy-structure openings and in the via openings at the same time.

15. The method of claim **8** wherein the elevationally-extending transistors are memory cells.

16. A method used in forming an array of elevationally-extending transistors and a circuit structure adjacent thereto, comprising:

forming a first stack of vertically-alternating tiers of different composition materials one of which comprises first sacrificial material;

forming elevationally-extending channel openings into the vertically-alternating tiers in the first stack, the channel openings individually comprising second sacrificial material therein;

forming a second stack of vertically-alternating tiers of different composition materials one of which comprises third sacrificial material;

forming channel openings into the vertically-alternating tiers in the second stack that individually elevationally extend to a different one of the channel openings in the first stack having the second sacrificial material therein;

removing the second sacrificial material from the channel openings in the first stack through the channel openings in the second stack;

after the removing, forming transistor channel material in individual of the channel openings in each of the first and second stacks;

forming a stair step structure comprising steps individually comprising one of the first sacrificial material or the second sacrificial material above one of the other different composition materials of the first or second stack, the stair step structure comprising insulating material above the steps;

forming operative conductive vias individually extending elevationally through the insulating material, through one of the steps, and through the vertically-alternating tiers of the first and second stacks at least to a bottom of the vertically-alternating tiers; the operative conductive vias individually electrically coupling to an electronic component below the vertically-alternating tiers;

forming dummy structures individually extending elevationally through the insulating material, through the vertically-alternating tiers, and through one of the steps at least to the bottom of the vertically-alternating tiers; and

after forming the dummy structures and the operative conductive vias, etching away at least a majority of the second and third sacrificial materials from the stair step structure.

17. The method of claim **16** comprising forming the stair step structure before forming the transistor channel material in the individual channel openings in each of the first and second stacks.

18. The method of claim **16** comprising forming the stair step structure after forming the transistor channel material in the individual channel openings in each of the first and second stacks.

19. The method of claim **16** wherein there is no additional structure or material identifying an interface of the first stack with the second stack.

20. The method of claim **16** wherein etching away is of all of the second and third sacrificial materials from the stair step structure and further comprising replacing the second and third sacrificial materials with metal material whereby the stair step structure is fully metallized.

21. A device comprising:

an array of elevationally-extending transistors; and

a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array, the circuit structure comprising:

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a stair step structure comprising vertically-alternating tiers comprising conductive steps that are at least partially elevationally separated from one another by insulative material;

operative conductive vias individually extending elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers and which individually electrically couple to an electronic component below the vertically-alternating tiers; and

dummy structures individually extending elevationally through one of the conductive steps at least to the bottom of the vertically-alternating tiers.

22-40. (canceled)

41. A device comprising:

an array of elevationally-extending transistors; and

a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array, the circuit structure comprising:

a first stair step structure and an adjacent second stair step structure individually comprising vertically-alternating tiers comprising first and second opposing sets of conductive steps, the conductive steps being at least partially elevationally separated from one another by insulative material in each of the first and second stair step structures;

an elevationally-outer landing between the first stair step structure and the second stair step structure;

operative conductive vias in each of the first and second stair step structures, the operative conductive vias individually extending elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers of the respective first or second stair step structure and which individually electrically couple to an electronic component below the vertically-alternating tiers of the respective first or second stair step structure;

first dummy structures in each of the first and second stair step structures, the first dummy structures individually extending elevationally through one of the conductive steps at least to the bottom of the vertically-alternating tiers of the respective first or second stair step structure; and

a second dummy structure extending elevationally through the landing.

42. (canceled)

43. A device comprising:

an array of elevationally-extending transistors; and

a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array, the circuit structure comprising:

a stair step structure comprising vertically-alternating tiers comprising first and second opposing flights of conductive steps, the conductive steps being at least partially elevationally separated from one another by insulative material;

operative conductive vias individually extending elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers and which individually electrically couple to an electronic component below the vertically-alternating tiers;

first-flight-dummy structures individually extending elevationally through one of the first-flight conductive steps at least to the bottom of the vertically-alternating tiers; and

second-flight-dummy structures individually extending elevationally through one of the second-flight conductive steps at least to the bottom of the vertically-alternating tiers.

44-45. (canceled)

46. A device comprising:

an array of elevationally-extending transistors comprising memory cells; and

a circuit structure adjacent and electrically coupled to the elevationally-extending transistors of the array, the circuit structure comprising:

a first stair step structure and an adjacent second stair step structure individually comprising vertically-alternating tiers comprising first and second opposing flights of conductive steps, the conductive steps being at least partially elevationally separated from one another by insulative material in each of the first and second stair step structures;

operative conductive vias in each of the first and second stair step structures, the operative conductive vias individually extending elevationally through one of the conductive steps at least to a bottom of the vertically-alternating tiers of the respective first or second stair step structure and which individually electrically couple to an electronic component below the vertically-alternating tiers of the respective first or second stair step structure;

first-flight-dummy structures in each of the first and second stair step structures, the first-flight-dummy structures individually extending elevationally through one of the first-flight conductive steps in the respective first or second stair step structure at least to the bottom of the vertically-alternating tiers of the respective first or second stair step structure; and

second-flight-dummy structures in each of the first and second stair step structures, the second-flight-dummy structures individually extending elevationally through one of the second-flight conductive steps in the respective first or second stair step structure at least to the bottom of the vertically-alternating tiers of the respective first or second stair step structure.

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