Ministero dello Sviluppo Economico
DIREZIONE GENERALE SVILUPPO PRODUTTIVO E COMPETITIVITA'-
UFFICIO ITALIANO BREVETTI E MARCHI

RAPPORTO DI RICERCA

Numero della domanda
IO 69111
IT 201600127581

DOCUMENTI CONSIDERATI DI RILIEVO

Categoria	Citazione del documento con indicazione, se appropriata, delle parti rilevanti	Rivendicazioni rilevanti	CLASSIFICAZIONE DELLA DOMANDA (IPC)
X	US 2015/309074 A1 (KUO YUNG-HSIN [TW] ET AL) 29 October 2015 (2015-10-29) * paragraph [0018] - paragraph [0052]; figure 10 *	1-27	INV. G01R1/073 ADD. G01R1/067
X	US 2009/085593 A1 (YOSHIDA TAKUTO [JP] ET AL) 2 April 2009 (2009-04-02) * paragraph [0064] - paragraph [0068]; figures 8,9 *	1-27	G01R1/18
X	CN 102 466 739 B (MPI CORP) 9 April 2014 (2014-04-09) * the whole document *	1	
X	US 2008/139017 A1 (KIYOFUJI HIDEHIRO [JP] ET AL) 12 June 2008 (2008-06-12) * paragraph [0101] - paragraph [0109]; figure 10 *	1	
X	US 5 519 331 A (COWART LAWRENCE R [US] ET AL) 21 May 1996 (1996-05-21) * column 5, line 50 - column 8, line 42; figure 3a *	1	CAMPI TECNICI RICERCATI (IPC) G01R
X	US 2014/091826 A1 (CHUI KA NG [US]) 3 April 2014 (2014-04-03) * paragraph [0047] - paragraph [0051]; figure 10 *	1	
X	WO 2016/156248 A1 (TECHNOPROBE SPA [IT]) 6 October 2016 (2016-10-06) * page 9, line 4 - page 13, line 19; figure 2 *	1	

-/--

Questo rapporto di ricerca è stato redatto sulla base di tutte le rivendicazioni

Data di completamento della ricerca	Esaminatore
Munich	28 August 2017	Hijazi, Ali

CATEGORIA DEI DOCUMENTI CITATI

X : di particolare rilevanza se considerato singolarmente
Y : di particolare rilevanza se combinato con un altro documento della stessa categoria
A : informazione generica
O : divulgazione orale
P : documento intermedio

T : teoria o principio alla base dell'invenzione
E : documento brevettuale antecedente, ma pubblicato dopo o alla data di deposito
D : documento citato nella domanda
L : documento citato per altre ragioni
.....
& : membro della stessa famiglia di brevetti, documento corrispondente

1

EPO FORM 1503 07.08 (P04C74)

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DIREZIONE GENERALE SVILUPPO PRODUTTIVO E COMPETITIVITA'-
UFFICIO ITALIANO BREVETTI E MARCHI

RAPPORTO DI RICERCA

Numero della domanda
IO 69111
IT 201600127581

DOCUMENTI CONSIDERATI DI RILIEVO

Categoria	Citazione del documento con indicazione, se appropriata, delle parti rilevanti	Rivendicazioni rilevanti	CLASSIFICAZIONE DELLA DOMANDA (IPC)
L	Anonymous: "Rheophore", , 25 May 2017 (2017-05-25), pages 1-1, XP055400972, Retrieved from the Internet: URL:https://en.wiktionary.org/api/rest_v1/page/pdf/rheophore [retrieved on 2017-08-24] * the whole document * -----	1-27	

CAMPI TECNICI RICERCATI (IPC)

Questo rapporto di ricerca è stato redatto sulla base di tutte le rivendicazioni

Munich	Data di completamento della ricerca 28 August 2017	Esaminatore Hijazi, Ali

CATEGORIA DEI DOCUMENTI CITATI

X : di particolare rilevanza se considerato singolarmente
Y : di particolare rilevanza se combinato con un altro documento della stessa categoria
A : informazione generica
O : divulgazione orale
P : documento intermedio

T : teoria o principio alla base dell'invenzione
E : documento brevettuale antecedente, ma pubblicato dopo o alla data di deposito
D : documento citato nella domanda
L : documento citato per altre ragioni
.....
& : membro della stessa famiglia di brevetti, documento corrispondente

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ALLEGATO AL RAPPORTO DI RICERCA SULLA DOMANDA DI BREVETTO ITALIANO N.

IO 69111
IT 201600127581

Questo allegato enumera i membri della famiglia di brevetti relativi a documenti brevettuali citati nel summenzionato rapporto di ricerca.
I membri sono indicati come da database dell'Ufficio Europeo dei Brevetti al 28-08-2017
L'Ufficio Europeo dei Brevetti non si assume alcuna responsabilità per queste indicazioni, che vengono fornite a solo scopo informativo.

Documenti brevettuali citati nel rapporto di ricerca	Data di pubblicazione	Membri della famiglia di brevetti	Data di pubblicazione
US 2015309074 A1	29-10-2015	NONE	
US 2009085593 A1	02-04-2009	JP 5352170 B2	27-11-2013
		JP 2009085948 A	23-04-2009
		TW 200923384 A	01-06-2009
		US 2009085593 A1	02-04-2009
CN 102466739 B	09-04-2014	NONE	
US 2008139017 A1	12-06-2008	JP 2008145238 A	26-06-2008
		US 2008139017 A1	12-06-2008
US 5519331 A	21-05-1996	NONE	
US 2014091826 A1	03-04-2014	JP 6158023 B2	05-07-2017
		JP 2014074716 A	24-04-2014
		TW 201415037 A	16-04-2014
		US 2014091826 A1	03-04-2014
WO 2016156248 A1	06-10-2016	TW 201636623 A	16-10-2016
		WO 2016156248 A1	06-10-2016

EPO FORM P04A3

Per ulteriori dettagli riguardanti questo allegato, si veda la Gazzetta Ufficiale (OJ) dell'Ufficio Europeo dei Brevetti, N. 12/82

Ministero dello Sviluppo Economico

DIREZIONE GENERALE SVILUPPO PRODUTTIVO E COMPETITIVITA' -
UFFICIO ITALIANO BREVETTI E MARCHI

OPINIONE SCRITTA

N. dossier	Data di deposito *(gg/mm/aa)*	Data di priorità *(gg/mm/aa)*	N. domanda
IO69111	16.12.2016		IT201600127581

Classificazione Internazionale dei Brevetti (IPC)
INV. G01R1/073 ADD. G01R1/067 G01R1/18

Richiedente
TECHNOPROBE S.P.A.

Questa opinione fornisce indicazioni riguardanti i seguenti elementi:

- ☒ Riquadro N. I — Base dell'opinione
- ☐ Riquadro N. II — Priorità
- ☐ Riquadro N. III — Non-redazione di un'opinione a riguardo di novità, attività inventiva e applicazione industriale
- ☐ Riquadro N. IV — Violazione del requisito d'unità dell'invenzione
- ☒ Riquadro N. V — Dichiarazione motivata a riguardo di novità, attività inventiva o applicazione industriale; citazioni e spiegazioni giustificative della dichiarazione
- ☐ Riquadro N. VI — Particolari documenti citati
- ☒ Riquadro N. VII — Difetti particolari nella domanda
- ☒ Riquadro N. VIII — Osservazioni particolari a riguardo della domanda

	Esaminatore
	Hijazi, Ali

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OPINIONE SCRITTA

Riquadro N. I Base dell'opinione

1. Questa opinione è stata redatta sulla base delle ultime rivendicazioni depositate prima dell'inizio della ricerca nella tecnica anteriore.

2. Per quanto concerne eventuali sequenze di nucleotidi e/o amminoacidi descritte nella domanda e necessarie per l'invenzione di cui oggetto nelle rivendicazioni, questa opinione è stata redatta sulla base di:

   a. tipo di materiale:

   ☐ una sequenza di DNA

   ☐ una o più tabelle relative alla sequenza di DNA

   b. formato del materiale:

   ☐ cartaceo

   ☐ elettronico

   c. momento di deposito o presentazione:

   ☐ depositato insieme alla domanda al momento del deposito della medesima

   ☐ depositato insieme alla domanda in formato elettronico

   ☐ presentato successivamente al fine della ricerca d'anteriorità

3. ☐ Inoltre, ove sia stata depositata o presentata più di una versione o copia di una sequenza di DNA e/o tabella ad essa relativa, è stata presentata anche la dichiarazione obbligatoria che le informazioni contenute nelle copie successive o addizionali sono identiche a quelle nella domanda come depositata o che, in ogni caso, non vanno oltre il contenuto della domanda depositata originariamente.

4. Note aggiuntive:

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OPINIONE SCRITTA

Riquadro N. VDichiarazione motivata a riguardo di novità, attività inventiva o applicazione industriale; citazioni e spiegazioni giustificative della dichiarazione

1. 1. Dichiarazione

Novità (N)	Sì:	Rivendicazioni	3-27
	No:	Rivendicazioni	1, 2
Attività inventiva (IS)	Sì:	Rivendicazioni	
	No:	Rivendicazioni	1-27
Applicazione industriale (IA)	Sì:	Rivendicazioni	1-27
	No:	Rivendicazioni	

2. 2. Citazioni e spiegazioni

si veda l'allegato

Riquadro N. VII Difetti particolari nella domanda

si veda l'allegato

Riquadro N. VIII Osservazioni particolari a riguardo della domanda

si veda l'allegato

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2015/309074 A1 (KUO YUNG-HSIN [TW] ET AL) 29 October 2015 (2015-10-29)

D2 US 2009/085593 A1 (YOSHIDA TAKUTO [JP] ET AL) 2 April 2009 (2009-04-02)

D3 CN 102 466 739 B (MPI CORP) 9 April 2014 (2014-04-09)

D4 US 2008/139017 A1 (KIYOFUJI HIDEHIRO [JP] ET AL) 12 June 2008 (2008-06-12)

D5 US 5 519 331 A (COWART LAWRENCE R [US] ET AL) 21 May 1996 (1996-05-21)

D6 US 2014/091826 A1 (CHUI KA NG [US]) 3 April 2014 (2014-04-03)

D7 WO 2016/156248 A1 (TECHNOPROBE SPA [IT]) 6 October 2016 (2016-10-06)

D8 Anonymous: "Rheophore",
, 25 May 2017 (2017-05-25), pages 1-1, XP055400972,
Retrieved from the Internet:
URL:https://en.wiktionary.org/api/rest_v1/page/pdf/rheophore
[retrieved on 2017-08-24]

2 Novelty, inventive step (as far as the claims are clear, see Item VIII).

2.1 Independent claim 1.

2.1.1 The subject-matter of claim 1 is so unclear and so broad that it appears that any probe head with slidably mounted probes and having somewhere a capacitor would destroy its novelty (for instance the prior art acknowledged in

the application with Fig. 1). Therefore not all potential novelty (or inventive step) destroying documents have been cited but only those coming somehow closer to what could be understood from the description and figures.

2.1.2 D1 discloses:

A probe head (Fig. 10) comprising a plurality of contact probes (682) being slidably housed in respective pluralities of guide holes being realized in a plate-shaped support (the supports 670, 676), said plurality of contact probes comprising at least a first group of contact probes carrying ground and power supply signals (paragraph 0028), wherein at least one filtering capacitor having at least one rheophore being electrically connected to a conductive portion realized on said support and including at least one housing guide hole of a contact probe of said first group (see the capacitor 652 used as a decouping device, paragraphs 0036, 0041 and 0049).

2.1.3 D2 aslo discloses the subject-matter of claim 1, see Figs. 8 or 9, paragraphs 0064-0068. Pogo pins can be exchanged (paragraph 0059) and therefore such probes are "slidably" housed in the support.

2.1.4 D3 appears to be also very close to the claimed subject-matter and is at least inventive step prejudicial if not novelty destroying, see Figs. 3(a), (b) or (c) and the power probe 34 and ground probe 35.

2.1.5 D4 appears to be a disclosure similar to the one of D2, see especially Fig. 10 and paragraphs 0101 to 0109 and is also very close to the claimed subject-matter.

2.1.6 D5 appears also to disclose the subject-matter of claim 1, see Fig. 3a, the decoupling capacitors 326 placed on the board housing part of the probes 316a.

2.1.7 D6 could also be probably seen as novelty destroying, see Fig. 10, paragraphs 0047-0051, especially decoupling capacitor 1060.

2.1.8 The same applies to D7, e.g. Fig. 2 in view of the present wording of claim 1.

2.2 The additional subject-matter of the dependent claims appears to be either known from the documents cited (see e.g. claim 2 and e.g. the already quoted parts of D1 and D2 or to relate to obvious constructional details for the skilled person and not of such nature to confer inventive step to those claims (see e.g. claim 3).

3 All the claims are related to a probe head and therefore the claimed invention is considered to be industrially applicable.

Re Item VII

Certain defects in the application

4 D1 to D3 and the relevant background are not acknowledged in the description. Furthermore the document(s) reflecting the prior art described on pages 1 to 5, is(are) not identified in the description.

Re Item VIII

Certain observations on the application

5 The following claims are not clear.

5.1 Claim 1.

5.1.1 From the wording use it is not clear whether the plate-shaped support is part or not from the claimed probe head as it is not explicitly stated that the probe head comprises a plate-shaped support.

5.1.2 The feature "carrying ground and power supply signals" relates to a use of the probe head and is therefore unclear in an apparatus type claim like claim 1.

5.1.3 The feature "comprising at least one filtering capacitor" is unclear as it is not defined which part is comprising the capacitor: the probe head in general , the plate-shaped support, the probes?

5.1.4 The term "rheophore" is an unusual term with no clear meaning. Wiktionnary (D8) qualifies this term as obsolete while the IEC dictionary (http:// www.electropedia.org/) do not list this term at all. The claim put this word together with reference sign 31, while the description uses also the term "lead" (e.g. at paragraph 0091) for this reference sign and while the figures (e.g. Fig. 2A) shows what looks like a leadless chip capacitor. All in all it is not possible to know what is exactly meant with this term which has been interpreted as meaning some wire or electrode that can conduct electricity.

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5.1.5 The feature "including at least one housing guide hole" is unclear as it is not specified which part is "including" and as it is not clear if the housing guide hole is one of the guide hole mentioned earlier in the claim or another further one.

5.2 Claim 2.

5.2.1 The feature "connected to a first voltage reference ..." relates to a potential use of the probe head (as no power supply reference generator is claimed as being part of the probe head) and it is therefore unclear what kind of limitations it may have on the probe head itself.

5.2.2 The same applies to the connection of the second rheophore while this last term is also unclear, see point 5.1.4 above.

5.3 Claim 5. Here also it is not clear which parts comprises the distinct conductive portions and the objection concerning the connected to also applies here.

5.4 Claim 6. It is not clear from the wording "housing seat" alone what is meant as a feature for the support. See also the rheophore.

5.5 Claim 8. Similar objections as for claim 2 applies also here (connected, rheophore).

5.6 Claim 9.

5.6.1 The link between the "housing guide holes" and those mentioned in earlier claims is not clear (the same or other one).

5.6.2 The terms "diaphragm" in the present context are unclear and do not allow the reader to know what kind of limitation is meant with it.

5.7 Claims 10, 11, 13, 16, 17, 18, 21, 23, 26 and 27 uses the same or similar terms as discussed above and lead therefore to similar objections which are not repeated in details. Furthermore the claimed structure (most of the claims depending on all preceding) leads in some cases to a repetition of features without the reader knowing if the same or further was meant (as an example, see claim 27 possibly depending on claim 20).

5.8 Consequently, the application does not fulfil the requirements of clarity.

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PCT REQUEST

Print Out (Original in Electronic Form)

0	**For receiving Office use only**	
0-1	International Application No.	**PCT/EP2017/082180**
0-2	International Filing Date	**11 DEC 2017 (11.12.2017)**
0-3	Name of receiving Office and "PCT International Application"	**RO/EP**

0-4	**Form PCT/RO/101 PCT Request**	
0-4-1	Prepared Using	PCT Online Filing Version 3.5.000.251e MT/FOP 20141031/0.20.5.20
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	European Patent Office (EPO) (RO/EP)
0-7	**Applicant's or agent's file reference**	TEC076BWO
I	**Title of Invention**	Testing head having improved frequency properties
II	**Applicant**	
II-1	This person is	Applicant only
II-2	Applicant for	All designated States
II-4	Name	TECHNOPROBE S.p.A.
II-5	Address	Via Cavalieri di Vittorio Veneto, 2 23870 Cernusco Lombardone (Lecco) Italy
II-6	State of nationality	IT
II-7	State of residence	IT
III-1	**Applicant and/or inventor**	
III-1-1	This person is	Inventor only
III-1-3	Inventor for	All designated States
III-1-4	Name (LAST, First)	MAGGIONI, Flavio
III-1-5	Address	c/o TECHNOPROBE S.p.A. Via Cavalieri di Vittorio Veneto, 2 23870 Cernusco Lombardone (Lecco) Italy

PCT REQUEST

Print Out (Original in Electronic Form)

IV-1	**Agent or common representative; or address for correspondence**	
	The person identified below is hereby/ has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	Agent
IV-1-1	Name (LAST, First)	FERRARI, Barbara
IV-1-2	Address	BOTTI & FERRARI S.r.l. Via Cappellini, 11 20124 Milano Italy
IV-1-3	Telephone No.	+39 02 6704275
IV-1-4	Facsimile No.	+39 02 6703250
V	**DESIGNATIONS**	
V-1	**The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.**	
VI-1	**Priority claim of earlier national application**	
VI-1-1	Filing date	16 December 2016 (16.12.2016)
VI-1-2	Number	102016000127581
VI-1-3	Country or Member of WTO	IT
VI-2	**Priority claim of earlier national application**	
VI-2-1	Filing date	24 February 2017 (24.02.2017)
VI-2-2	Number	102017000021389
VI-2-3	Country or Member of WTO	IT
VI-3	**Incorporation by reference :**	
	where an element of the international application referred to in Article 11(1)(iii)(d) or (e) or a part of the description, claims or drawings referred to in Rule 20.5(a) is not otherwise contained in this international application but is completely contained in an earlier application whose priority is claimed on the date on which one or more elements referred to in Article 11(1)(iii) were first received by the receiving Office, that element or part is, subject to confirmation under Rule 20.6, incorporated by reference in this international application for the purposes of Rule 20.6.	
VII-1	**International Searching Authority Chosen**	European Patent Office (EPO) (ISA/EP)

PCT REQUEST

Print Out (Original in Electronic Form)

VII-2	**Request to use results of earlier search; reference to that search**	
VII-2-1	Filing date	16 December 2016 (16.12.2016)
VII-2-2	Application Number	102016000127581
VII-2-3	Country (or regional Office)	IT
VII-2-5	Documents are available to the ISA in a form and manner acceptable to it and therefore do not need to be submitted by the applicant to the ISA (Rule 12bis.1(f)):	A copy of the results of the earlier search A copy of the earlier application A copy of any document cited in the results of the earlier search
VII-3	**Request to use results of earlier search; reference to that search**	
VII-3-1	Filing date	24 February 2017 (24.02.2017)
VII-3-2	Application Number	102017000021389
VII-3-3	Country (or regional Office)	IT
VII-3-4	Statement (Rule 4.12(ii)):	This international application is the same, or substantially the same, as the application in respect of which the earlier search was carried out except, where applicable, that it is filed in a different language.
VII-3-5	Documents are available to the ISA in a form and manner acceptable to it and therefore do not need to be submitted by the applicant to the ISA (Rule 12bis.1(f)):	A copy of the results of the earlier search A copy of the earlier application A copy of any document cited in the results of the earlier search

VIII	**Declarations**	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	–	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	–	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	–	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	–	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	–	

PCT REQUEST

Print Out (Original in Electronic Form)

IX	Check list	Number of sheets	Electronic file(s) attached
IX-1	Request (including declaration sheets)	4	✓
IX-2	Description	32	✓
IX-3	Claims	5	✓
IX-4	Abstract	1	✓
IX-5	Drawings	13	✓
IX-7	TOTAL	55	
	Accompanying Items	Paper document(s) attached	Electronic file(s) attached
IX-8	Fee calculation sheet	–	✓
IX-19	Other	Pre-conversion archive	✓
IX-20	**Figure of the drawings which should accompany the abstract**	2A	
IX-21	**Language of filing of the international application**	English	
X-1	**Signature of applicant, agent or common representative**	(PKCS7 Digital Signature)	
X-1-1	Name (LAST, First)	FERRARI, Barbara	
X-1-3	Capacity (if such capacity is not obvious from reading the request)	(Representative)	

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	11 DEC 2017 (11.12.2017)
10-2	**Drawings:**	✓
10-2-1	Received	
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	
10-4	**Date of timely receipt of the required corrections under PCT Article 11(2)**	
10-5	**International Searching Authority**	ISA/EP
10-6	**Transmittal of search copy delayed until search fee is paid**	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	**Date of receipt of the record copy by the International Bureau**	

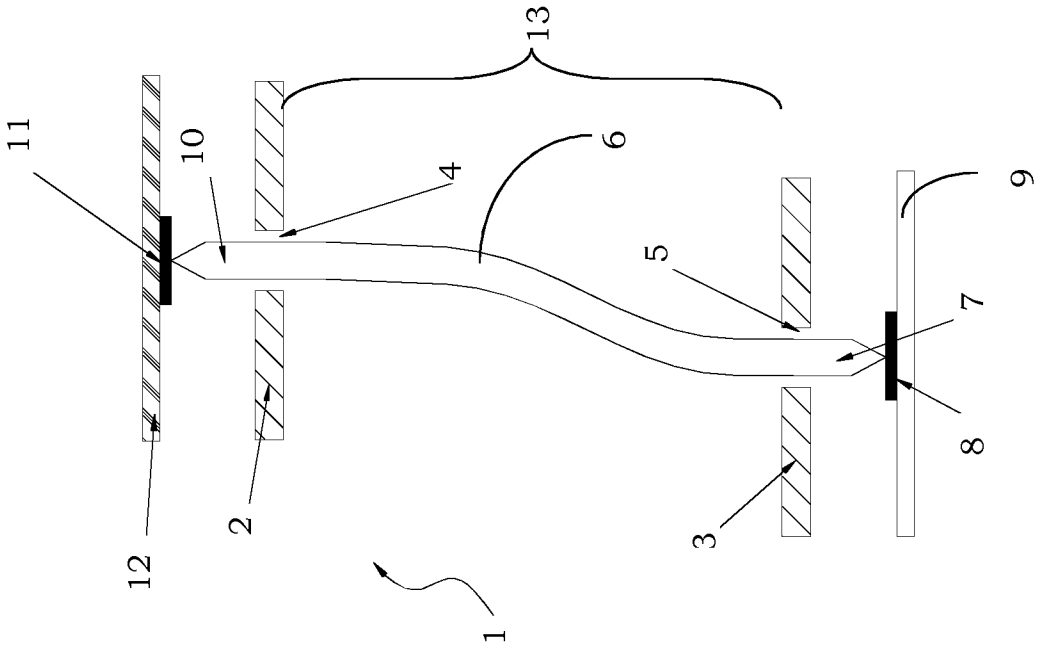


FIG. 1
PRIOR ART

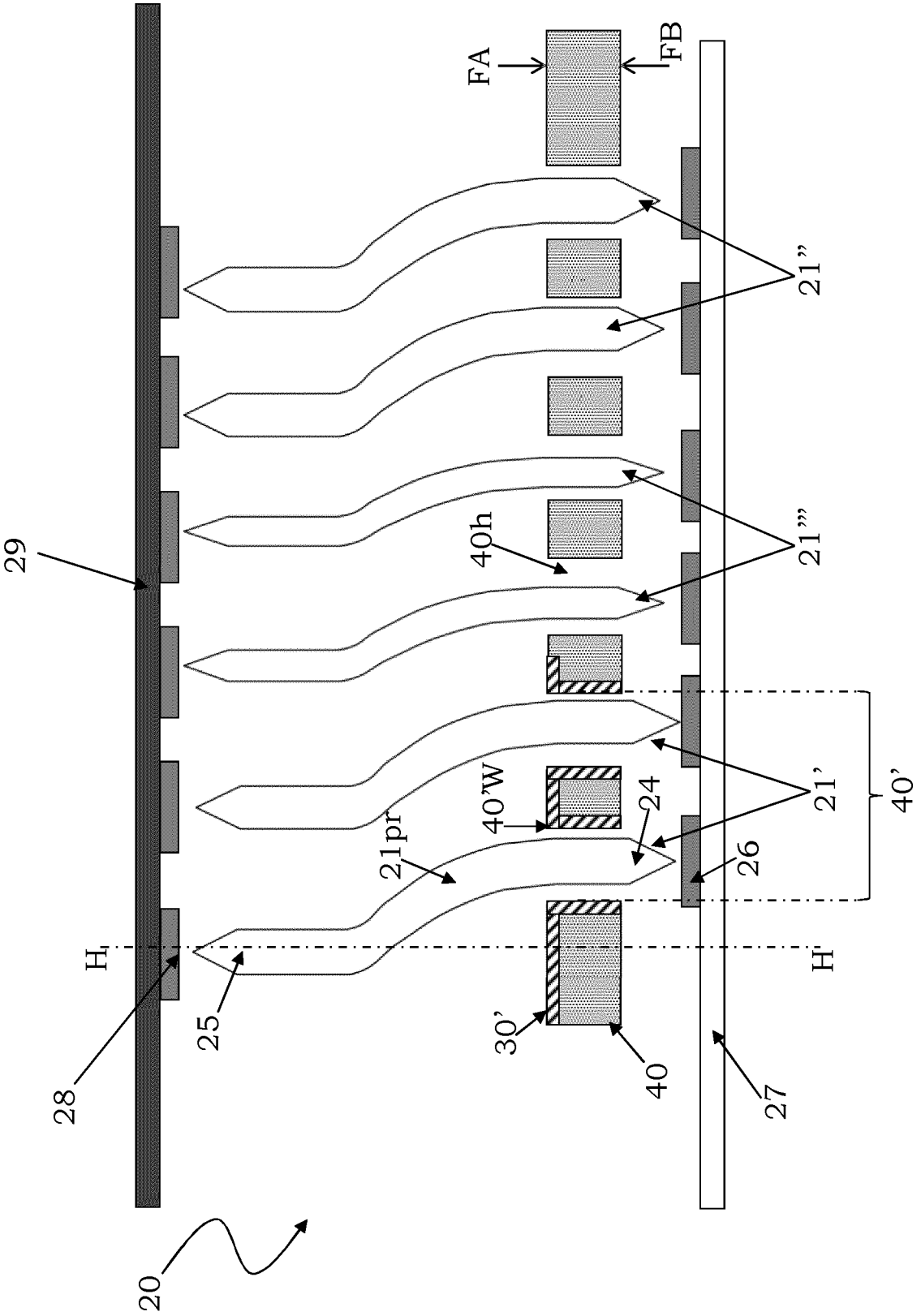


FIG. 2A

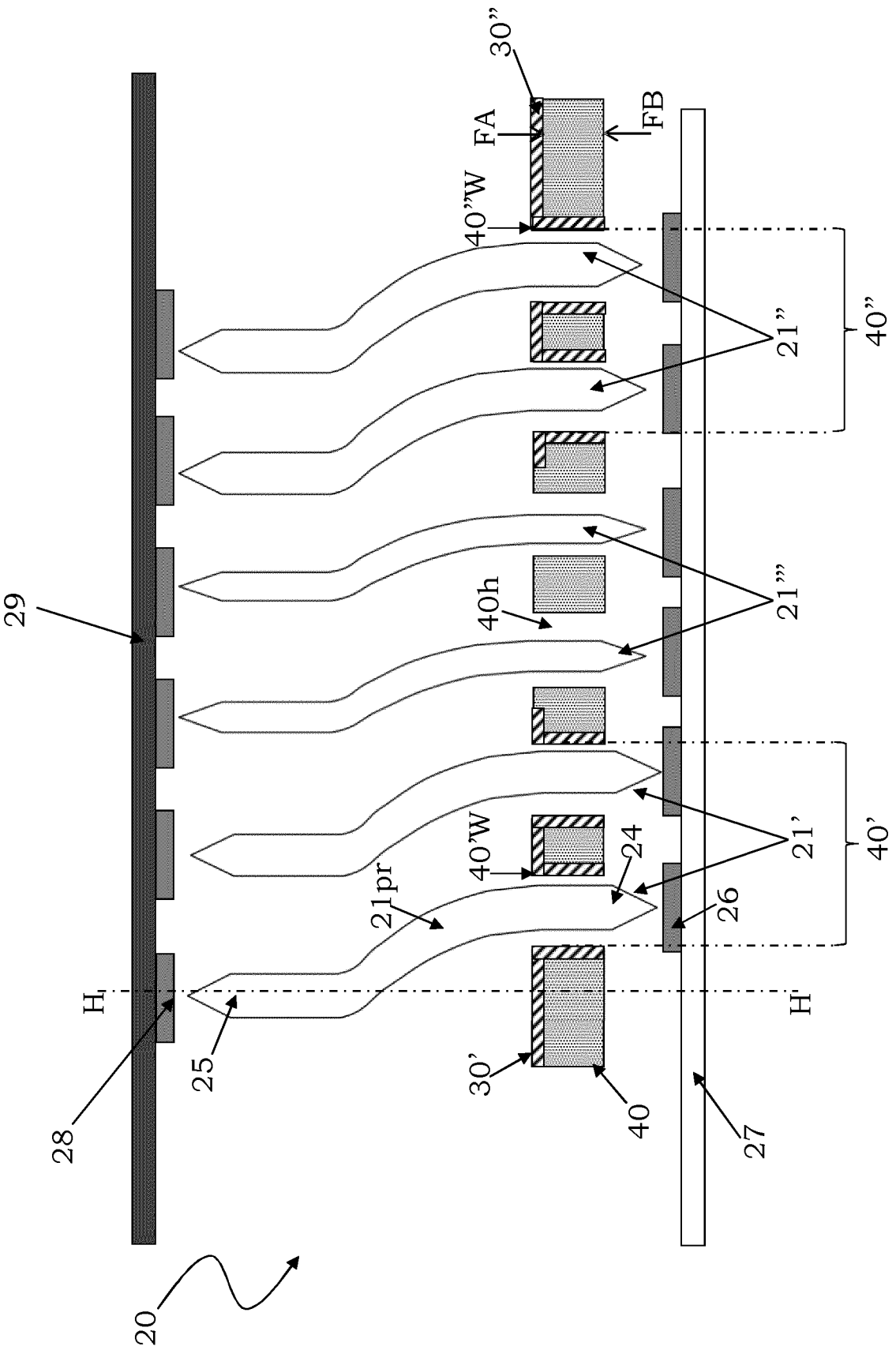


FIG. 2B

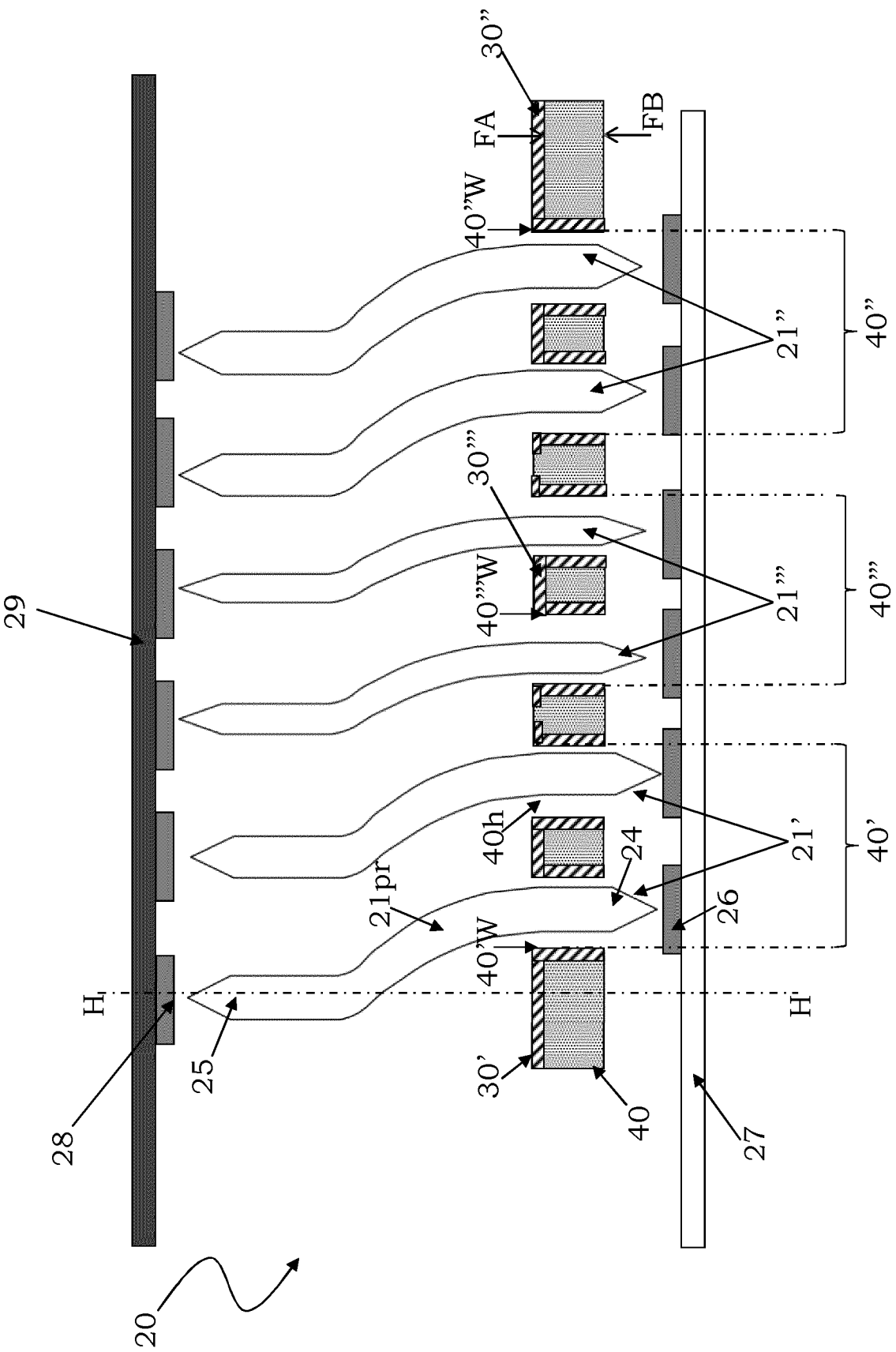

20
28
25
29
H
H'
30'
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27
40'W
40h
21pr
24
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40'
30'''
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21'''
40'''
30''
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FA
FB
21''
40''

FIG. 2C

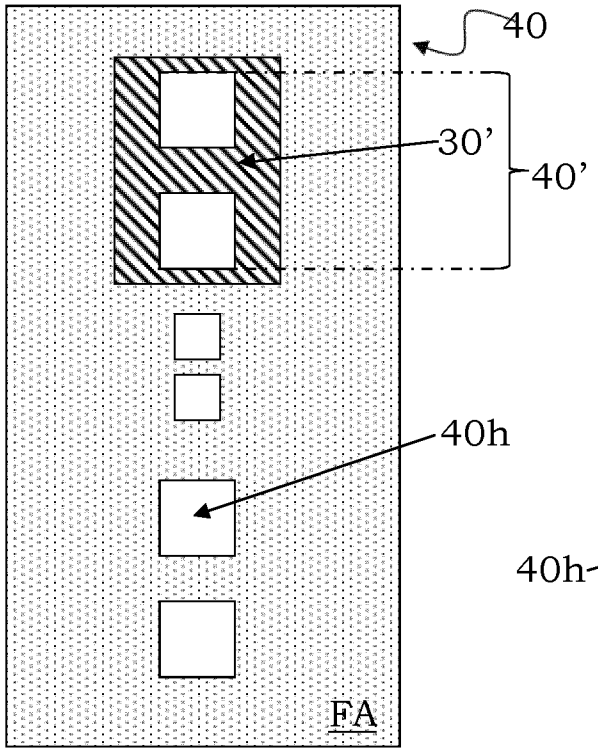


FIG. 3A

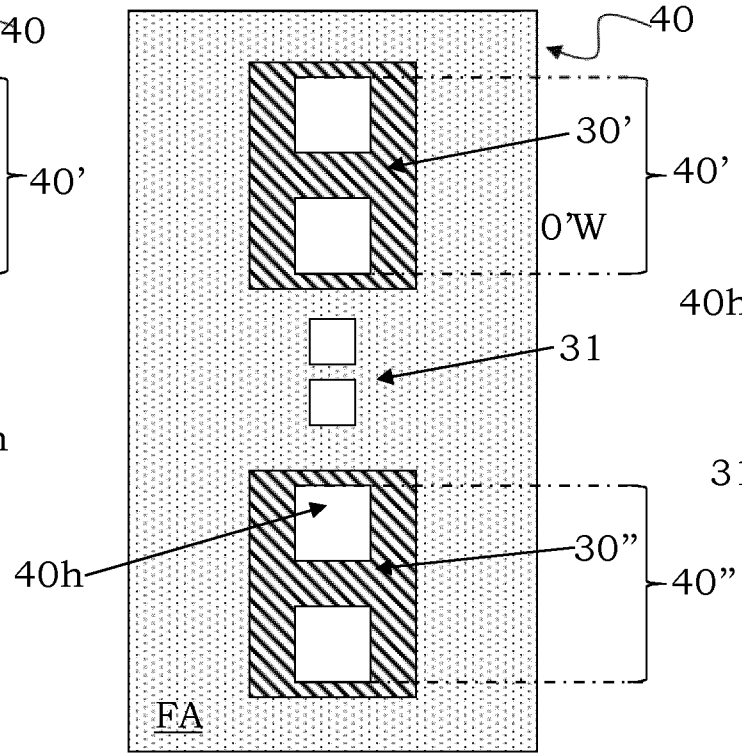


FIG. 3B

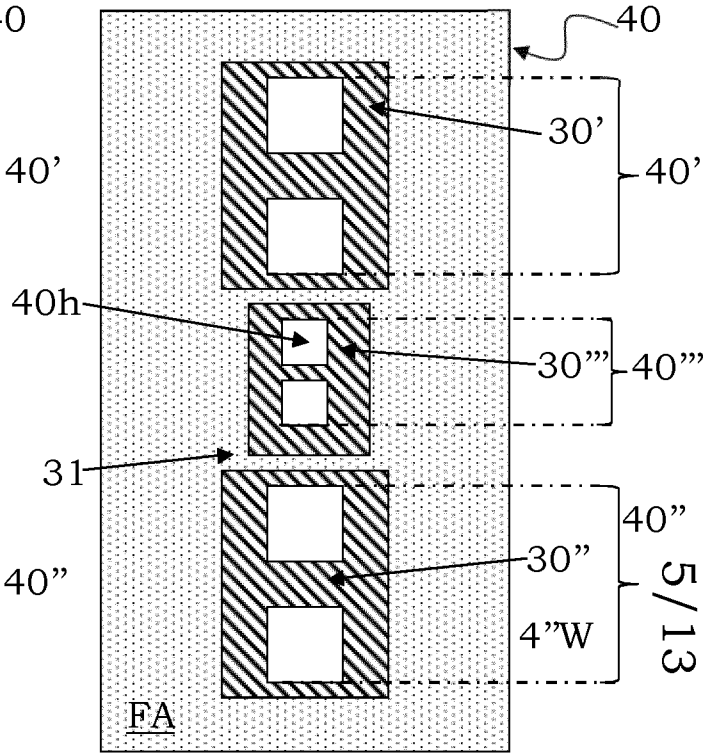


FIG. 3C

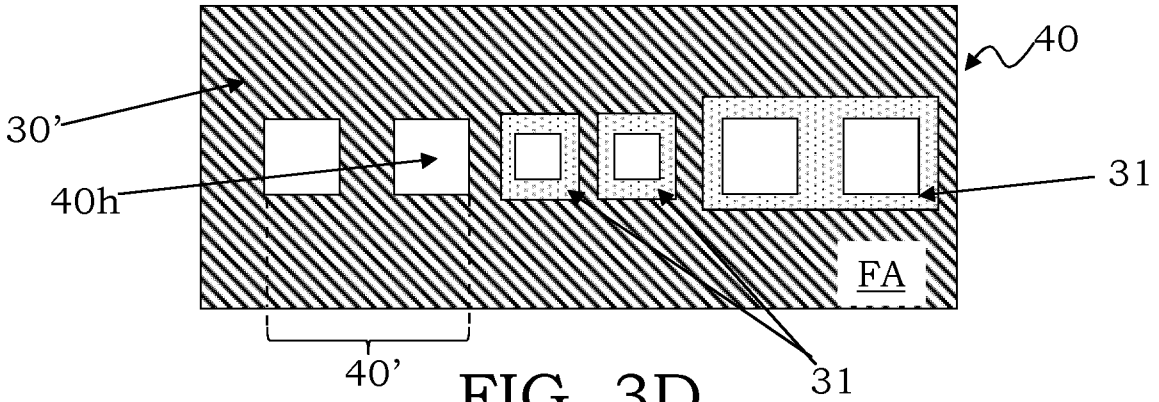


FIG. 3D

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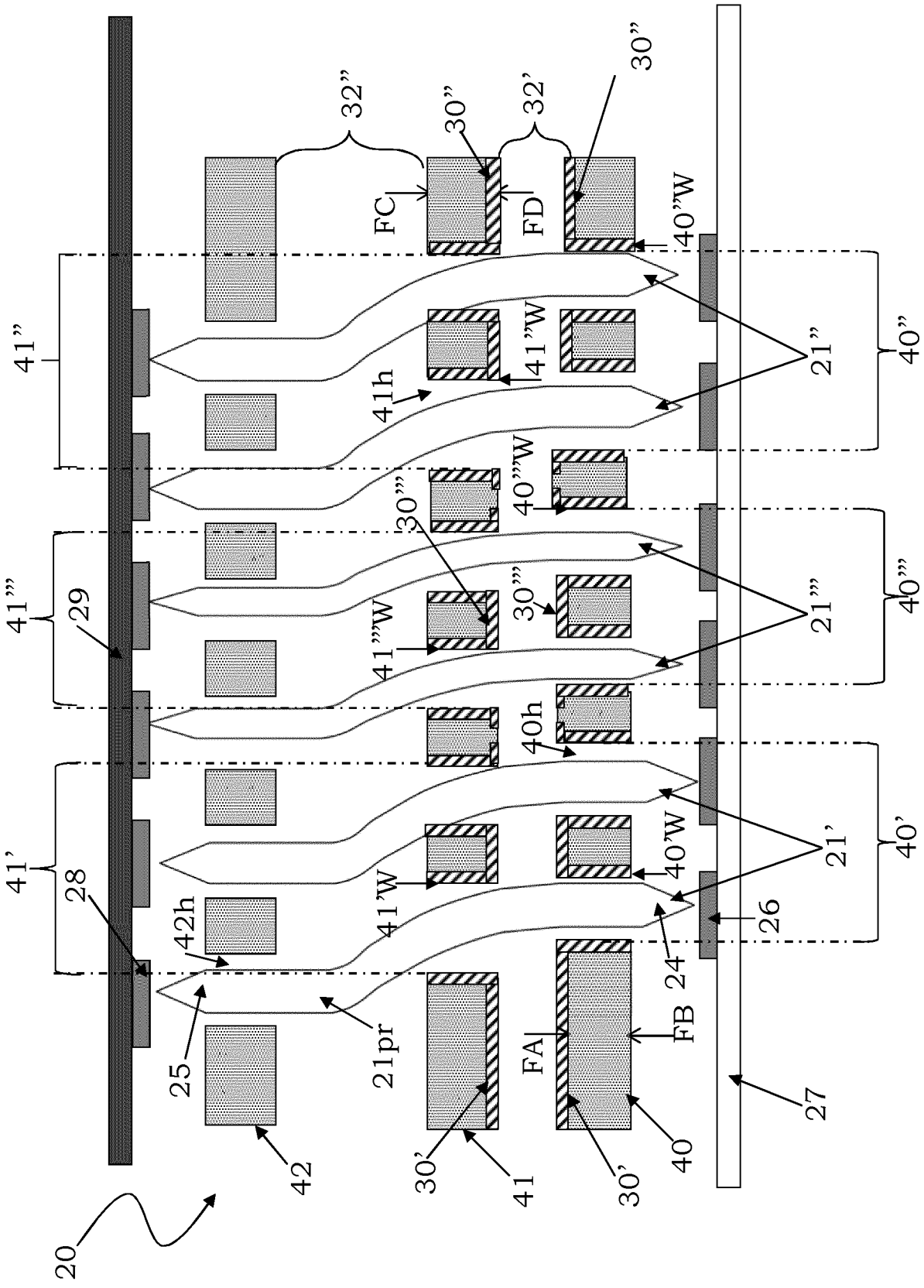

20
42
25
42h
28
41'
29
41''
41'''
30'
41
30'
41'W
41''W
41'''W
30'''
30''
32''
30''
32'
30''
FC
FD
40''W
41h
40'''W
40h
40'W
21pr
FA
FB
24
26
27
40
21'
21''
21'''
40'
40''
40'''

FIG. 4A

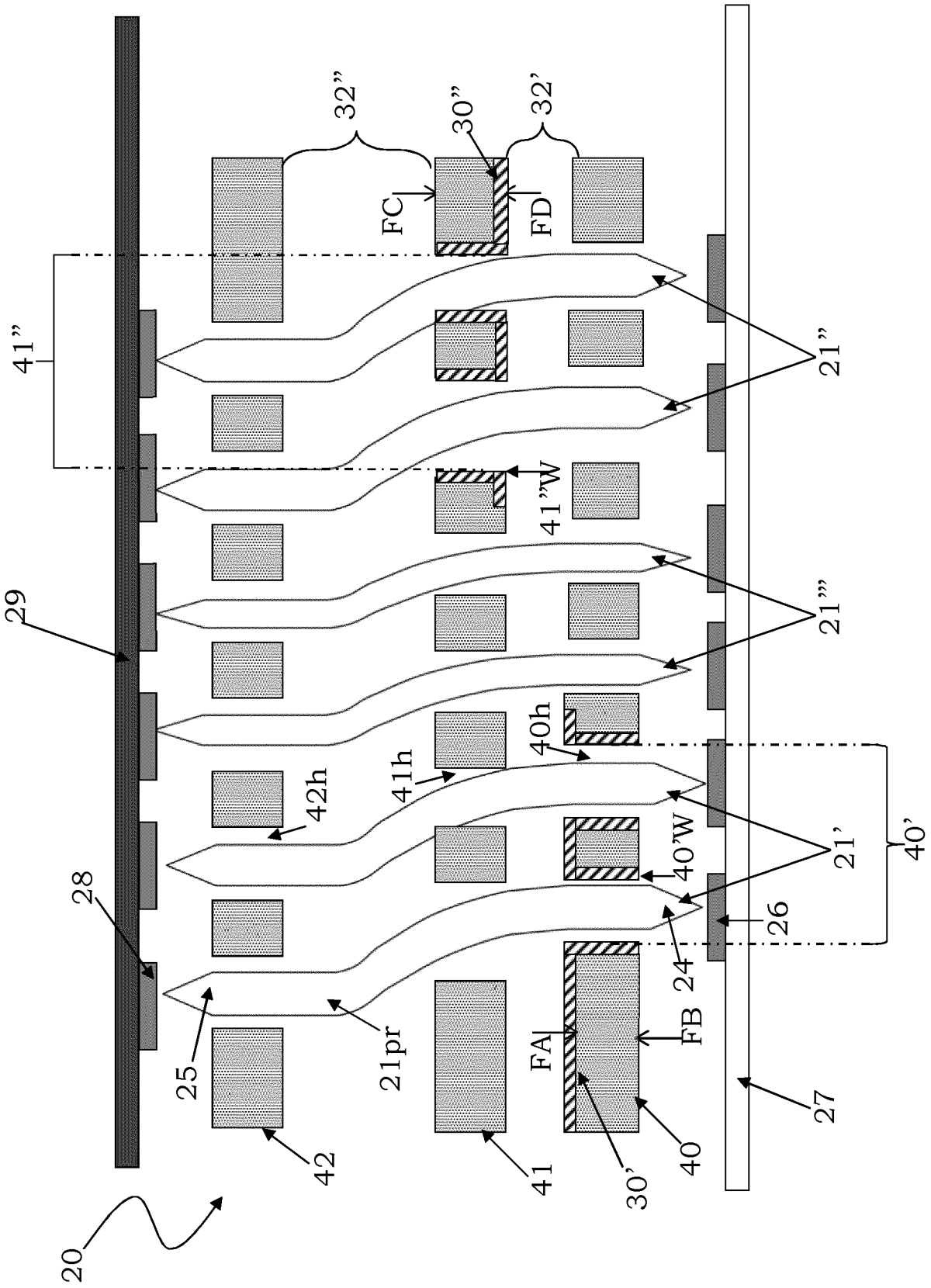

20
25
28
29
41”
42
42h
41
41h
21pr
30’
FA
40
40h
FB
24
40’W
21’
40’
26
27
41”W
30”
32”
32’
FC
FD
21”
21”’

FIG. 4B

FIG. 5A

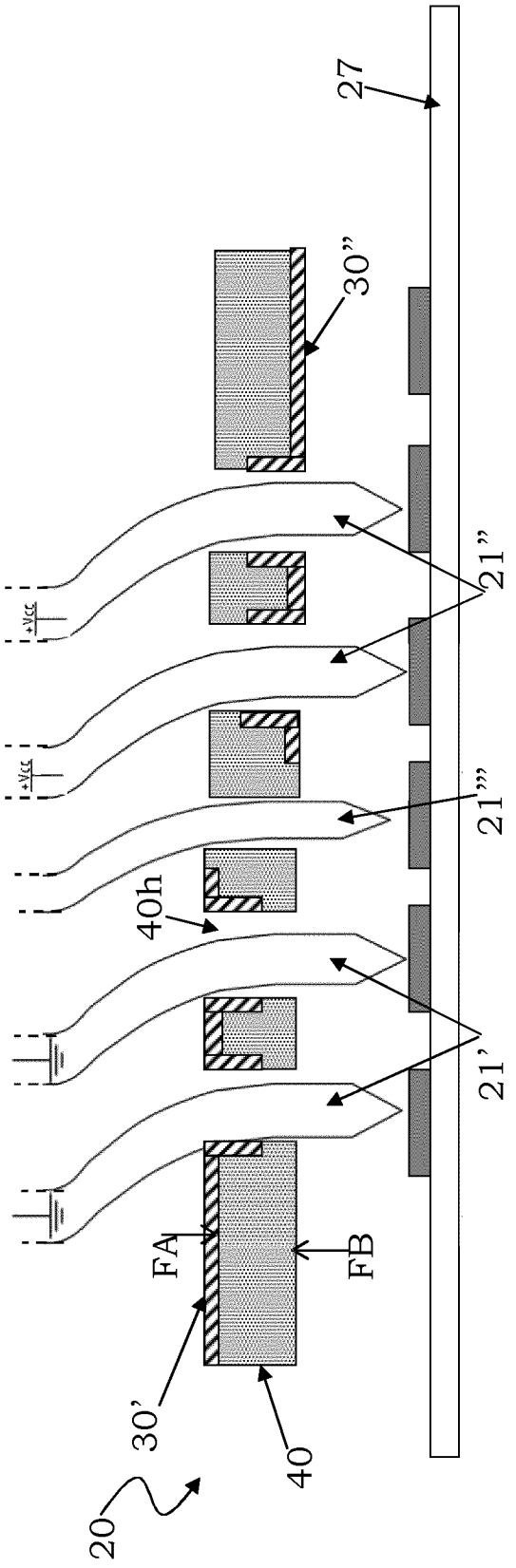
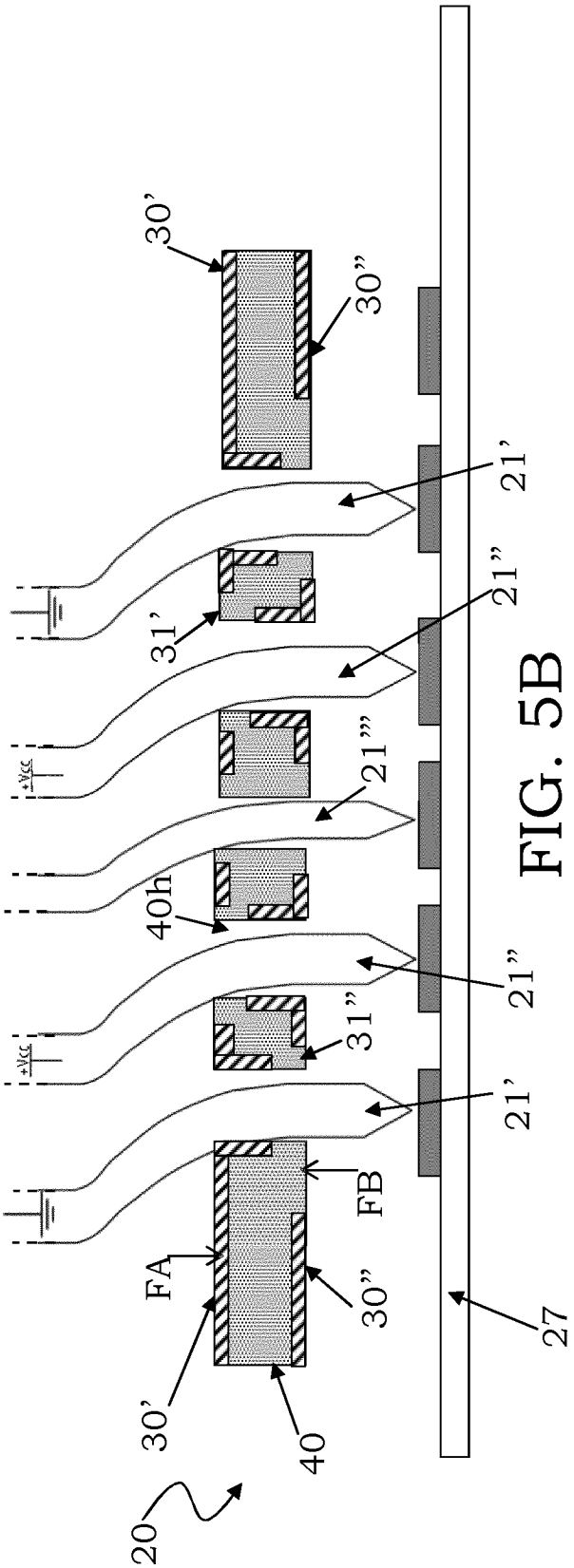

27
30”
21”
21’”
40h
21’
FA
FB
30’
40
20

FIG. 5B


30’
30”
21’
21”
31’
21’”
40h
31”
21”
21’
FA
FB
30”
30’
40
20
27

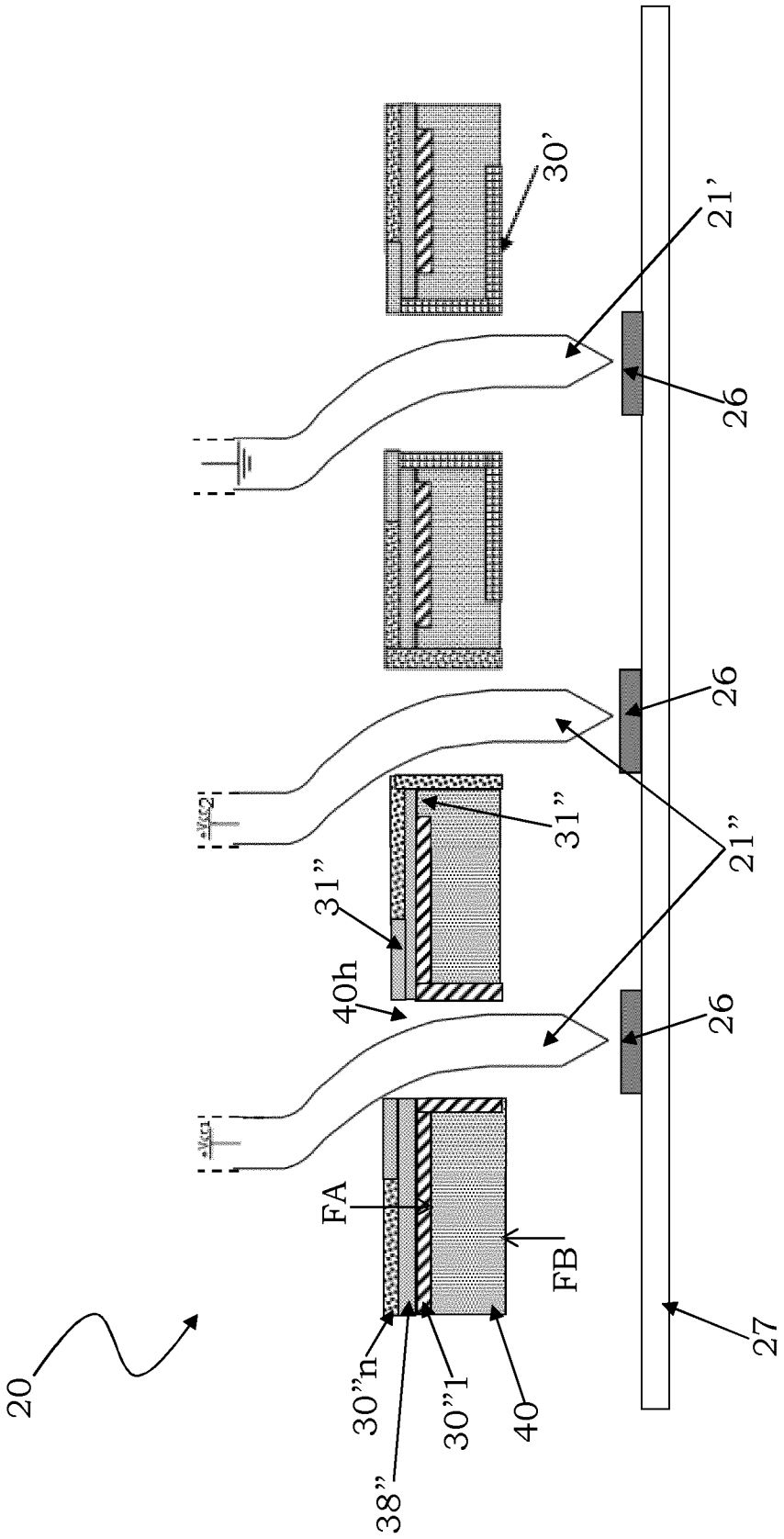


FIG. 6

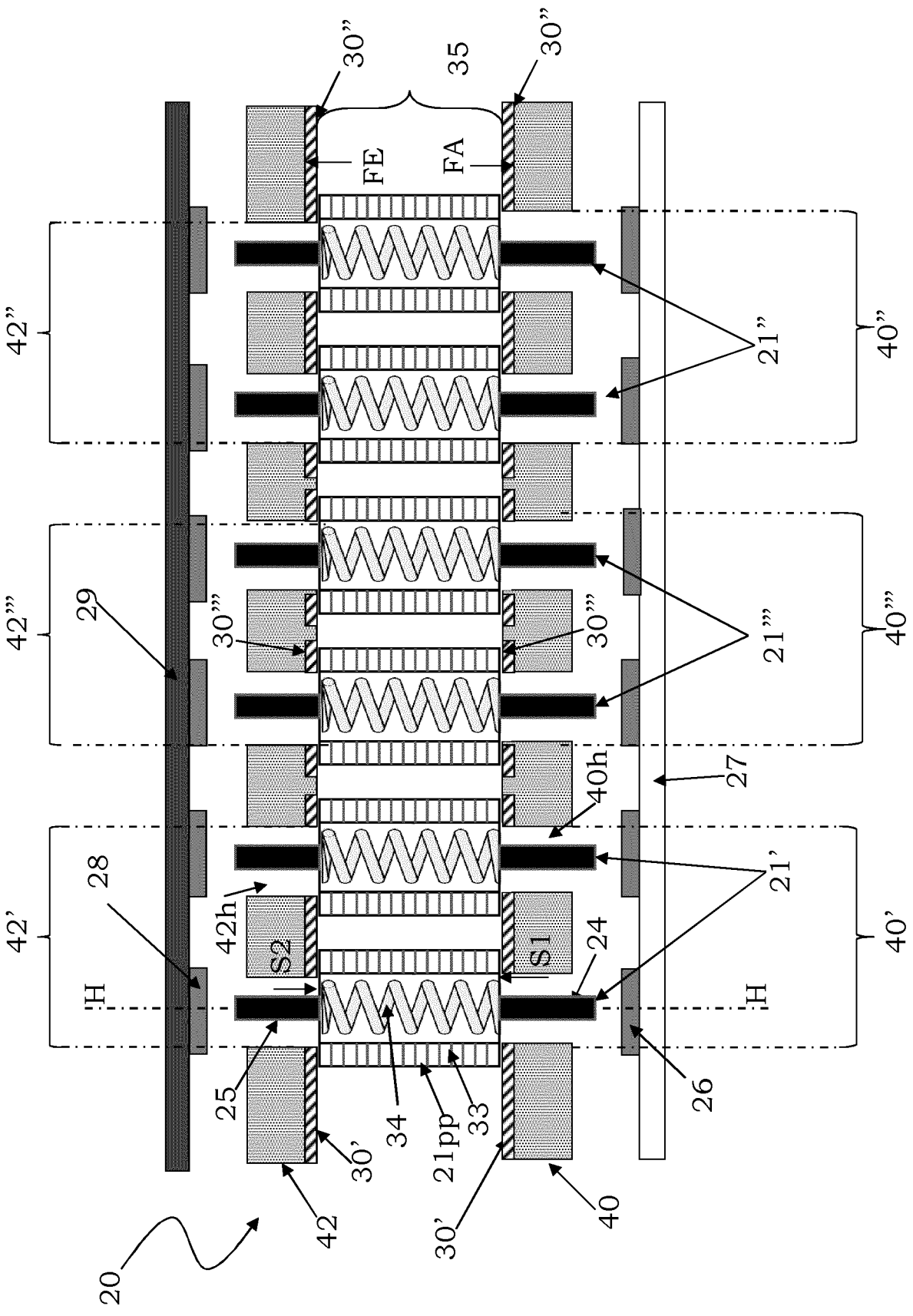

30”
35
30”
FE
FA
42”
21”
40”
42”’
29
30”’
30”’
21”’
40”’
40h
27
42’
28
42h
S2
S1
24
21’
40’
H
H
25
34
21pp
33
26
30’
42
30’
40
20

FIG. 7

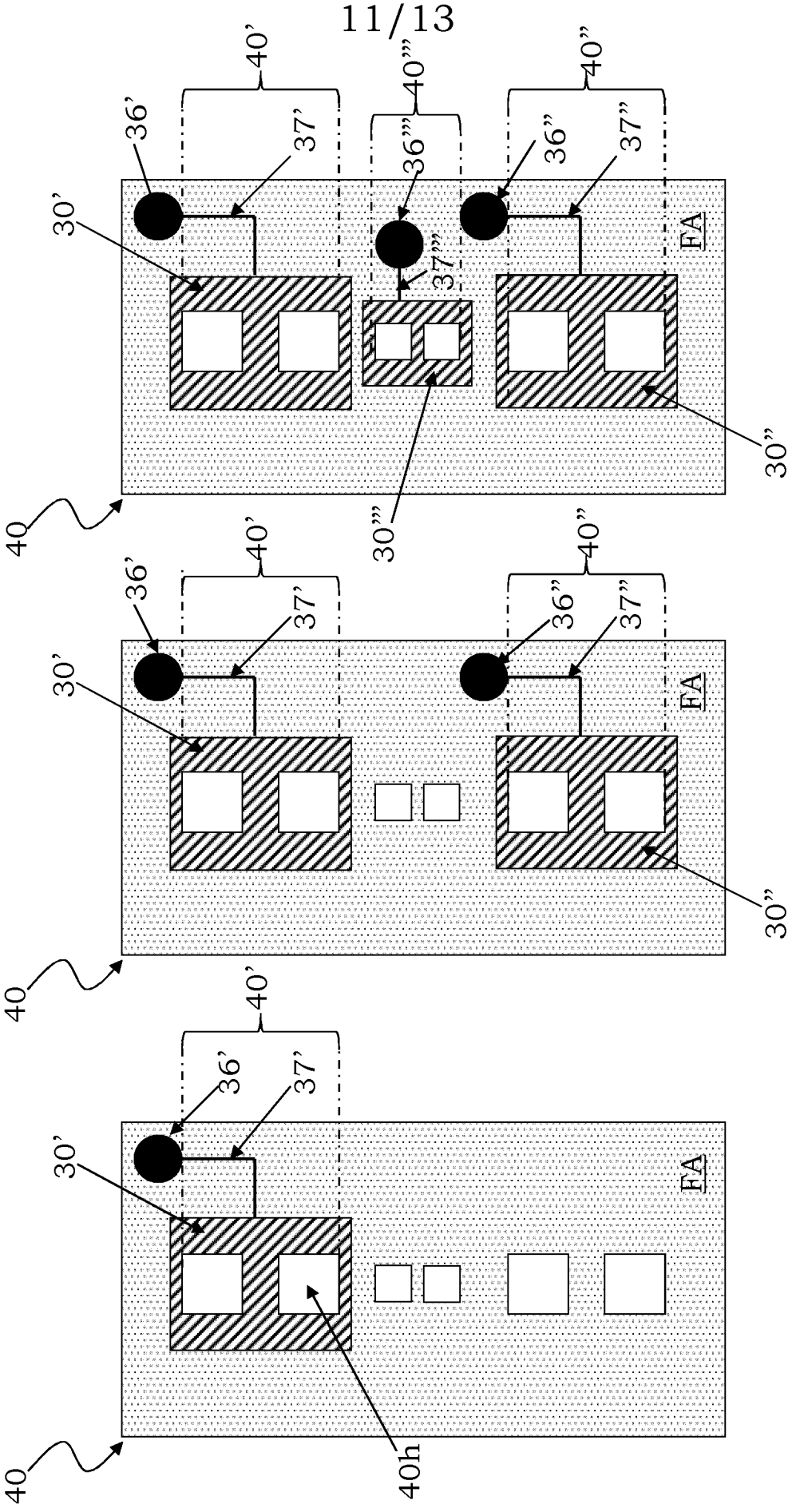


FIG. 8A

FIG. 8B

FIG. 8C

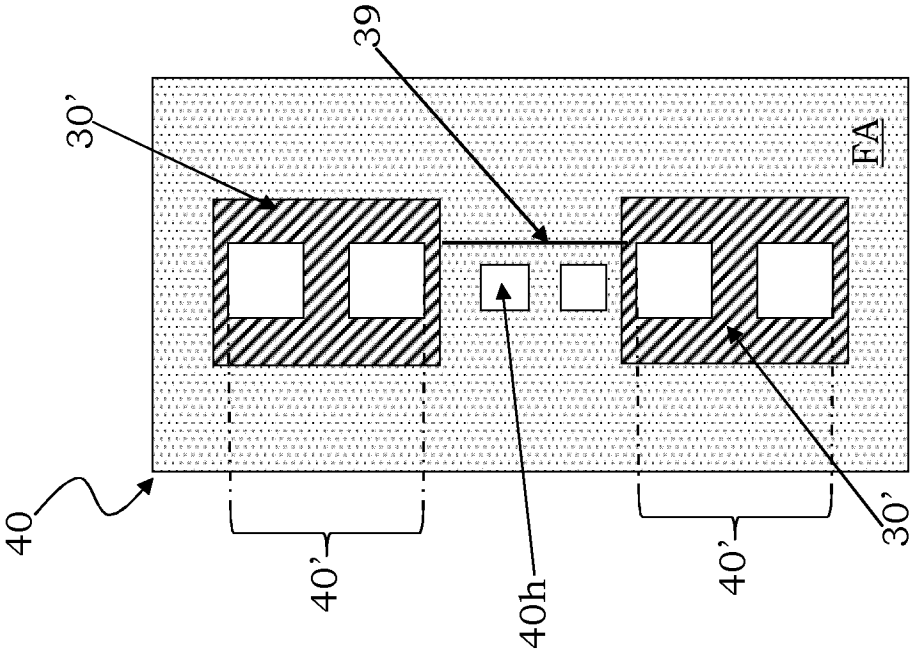

39
30’
FA
40
40’
40h
40’
30’

FIG. 9B

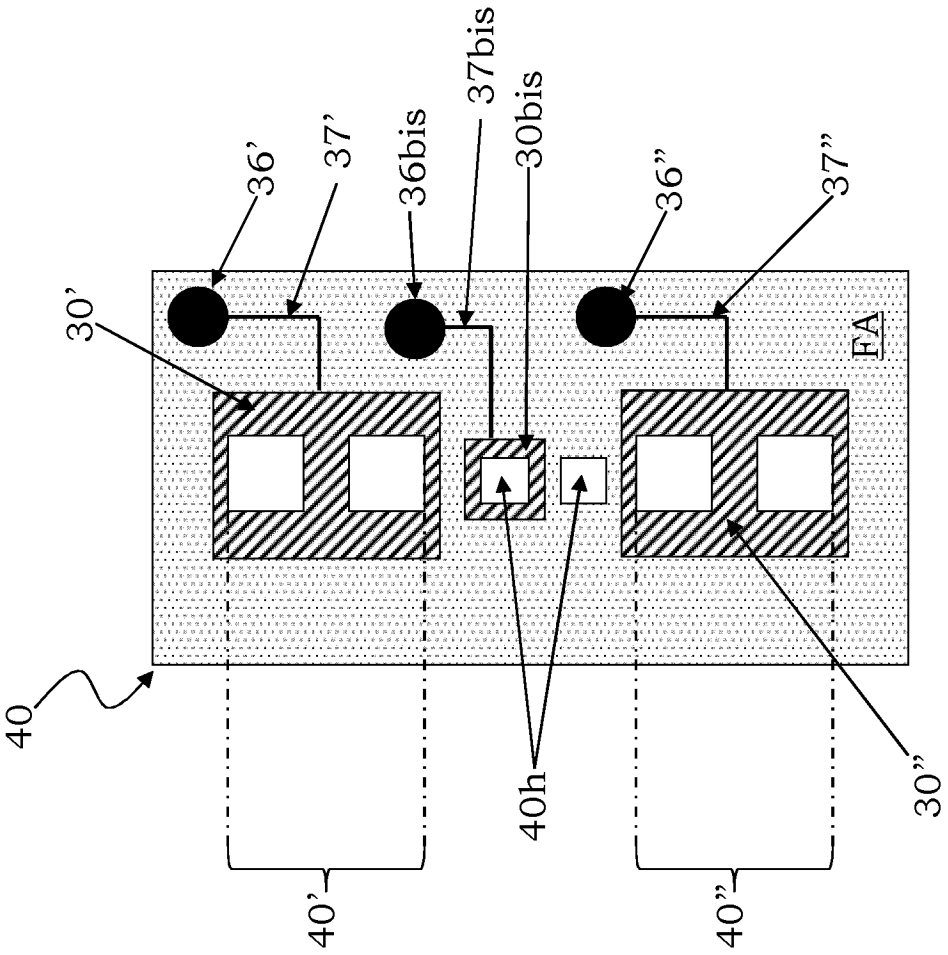

37bis
36’
37’
36bis
30bis
36”
37”
30’
FA
40
40h
30”
40’
40”

FIG. 9A

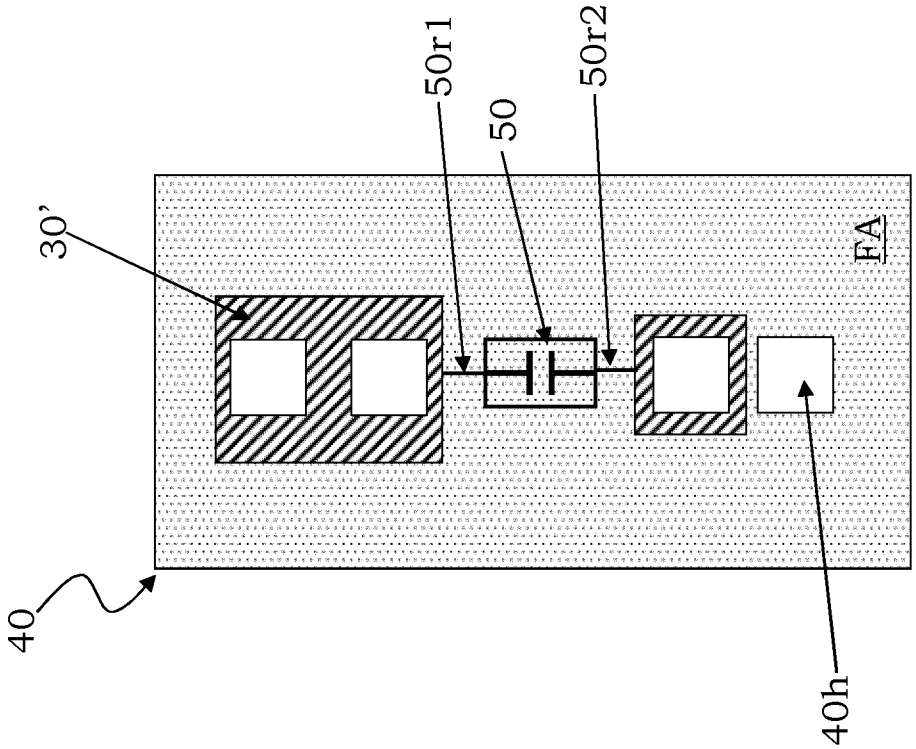


FIG. 10B

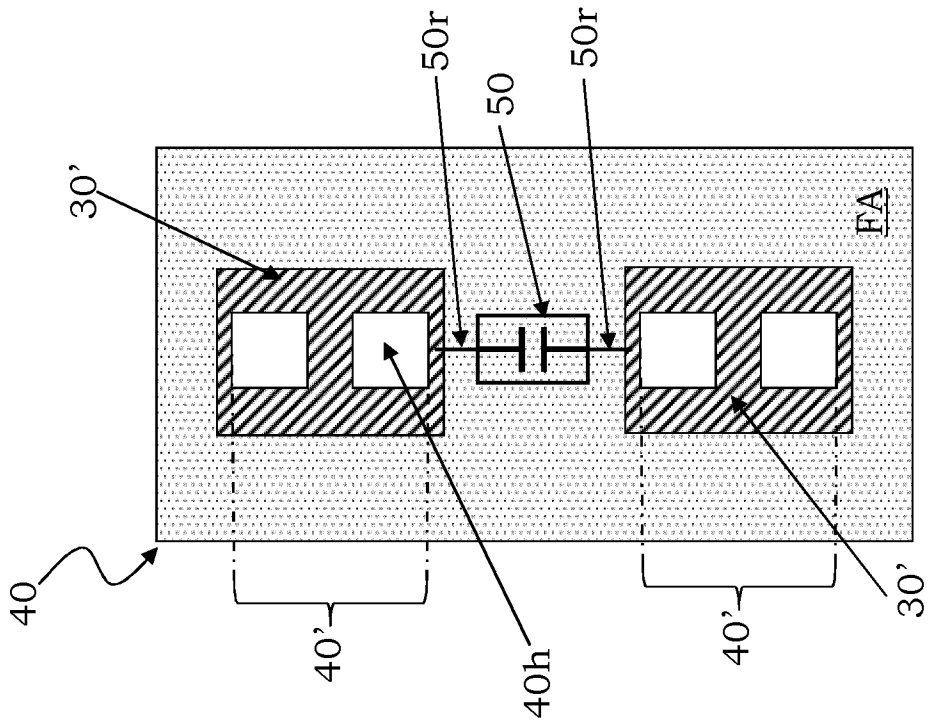


FIG. 10A

PCT (ANNEX - FEE CALCULATION SHEET)

Print Out (Original in Electronic Form)

(This sheet is not part of and does not count as a sheet of the international application)

0	**For receiving Office use only**	
0-1	International Application No.	**PCT/EP2017/082180**
0-2	Date stamp of the receiving Office	**11 DEC 2017 (11.12.2017)**

0-4	**Form PCT/RO/101 (Annex)** **PCT Fee Calculation Sheet**				
0-4-1	Prepared Using		PCT Online Filing Version 3.5.000.251e MT/FOP 20141031/0.20.5.20		
0-9	**Applicant's or agent's file reference**		TEC076BWO		
2	**Applicant**		TECHNOPROBE S.P.A.		
12	**Calculation of prescribed fees**		Fee amount/multiplier	Total amounts (EUR)	
12-1	Transmittal fee	**T**	➪	130	
12-2-1	Search fee	**S**	➪	1875	
12-2-2	International search to be carried out by		EP		
12-3	International filing fee (first 30 sheets)	**i1**	1219		
12-4	Remaining sheets		25		
12-5	Additional amount	**(X)**	14		
12-6	Total additional amount	**i2**	350		
12-7	i1 + i2 =	**i**	1569		
12-12	Electronic Filing reduction (Image)	**R**	−183		
12-13	Total International filing fee (i-R)	**I**	➪	1386	
12-14	Fee for priority document Number of priority documents requested		0		
12-15	Fee per document	**(X)**	50		
12-16	Total priority document fee:	**P**	➪		
12-17	Fee for restoration of priority rights Number of requests for restoration of priority rights	**RP**	0		
	Total amount of fees for restoration of priority rights				
12-19	**TOTAL FEES PAYABLE (T+S+I+P+RP)**		➪	3391	
12-21	**Mode of payment**		Other : No payment for the time being		

Title: "Testing head having improved frequency properties"

DESCRIPTION

Field of application

The present invention relates to a testing head for testing electronic devices integrated on a semiconductor substrate. More in particular, the present invention relates to a testing head comprising at least one guide provided with a plurality of guide holes adapted to house a plurality of contact elements, and the following description is made with reference to this application field with the only purpose of simplifying the exposition.

Prior art

As it is well known, a testing head (probe head) is essentially a device adapted to place a plurality of contact pads of a microstructure, such as an electronic device integrated on a wafer, into electrical contact with corresponding channels of a testing machine performing the working test thereof, in particular the electrical one, or generically the test.

The test, which is performed on integrated devices, is particularly useful to detect and isolate defective devices yet in the manufacturing step. Generally, the testing heads are thus used to electrically test the devices that are integrated on a wafer before cutting and assembling them inside a chip containing package.

Generally, a testing head comprises a plurality of contact elements or contact probes retained by at least one guide or by at least one pair of guides (or supports) which are substantially plate-shaped and parallel to each other. Those guides are provided with suitable holes and are arranged at a certain distance from each other so as to leave a free space or air gap for the movement and the possible deformation of the contact probes, which are slidingly housed in those guide holes. The

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pair of guides comprises in particular an upper guide and a lower guide, both provided with respective guide holes where the contact probes axially slide, the probes being usually made of wires of special alloys having good electrical and mechanical properties.

The good connection between the contact probes and the contact pads of the device under test is guaranteed by pressing the testing head on the device itself, the contact probes undergoing a bending inside the air gap between the guides and a sliding within the respective guide holes during that pressing contact. Testing heads of this kind are usually called "vertical probe head".

Substantially, the vertical probe testing heads have a gap in which the bending of the contact probes occurs, the bending being possibly assisted by means of a suitable configuration of the probes themselves or of their guides, as schematically shown in Figure 1.

In particular, figure 1 schematically shows a testing head 1 comprising at least one upper guide 2, usually indicated as “upper die”, and a lower guide 3, usually indicated as “lower die”, separated by a gap 13, having respective guide holes 4 and 5 in which a plurality of contact probes 6 slides, only one probe of the plurality of contact probes being shown in figure 1 for the sake of simplicity.

Each contact probe 6 terminates at an end with a contact tip 7 adapted to abut onto a contact pad 8 of a device under test integrated on a wafer 9, in order to carry out the mechanical and electrical contact between the device under test and a test equipment (not shown) of which such a testing head is a terminal element.

Here and hereinafter, the term “contact tip” indicates an end zone or region of a contact probe adapted to contact a contact pad of the device under test, such an end zone or region not necessarily being sharp.

In some cases, the contact probes are fixedly fastened to the testing head at the upper guide: in such cases, the testing heads are referred to as “blocked probe testing heads”.

More frequently, testing heads having probes not fixedly fastened are used, those probes being interfaced to a board, possibly by means of a micro-contact board: those testing heads are referred to as “non-blocked probe testing heads”. The micro-contact board is usually called "space transformer" since, besides contacting the probes, it also allows to spatially redistribute the contact pads made on it with respect to the contact pads of the device to be tested, in particular relaxing the distance constraints between the centers of the pads themselves.

In this case, as shown in figure 1, each contact probe 6 has a further end zone or region which terminates with a so-called contact head 10 towards a contact pad 11 of a plurality of contact pads of a space transformer 12. The good electrical contact between probes 6 and space transformer 12 is ensured by the pressing contact of the testing heads 10 of the contact probes 6 on the contact pads 11 of the space transformer 12, analogously to the contact between the contact tips 7 and the contact pads 8 of the device under test integrated on the wafer 9.

Contact elements in the form of pogo pins are also known in the art, the pogo pins essentially comprising an elastic body connected to two end portions, the elastic body compressing upon contact of the end portions with the contact pads of the device under test and of the space transformer.

Generally, inside a testing head, the contact elements are divided into contact elements adapted to carry power and ground signals towards the device under test, and into contact elements adapted to carry operating signals, in particular input/output signals, between the test equipment and the device under test.

In the case of a testing head of the kind described above, it is well known that the presence of several contact elements adapted to carry ground signals, as well as the presence of contact elements adapted to carry power signals, creates interferences, therefore causing noise in the input/output signals used for the test of the device under test, which limits the frequency performance of the testing head. In the case of contact elements adapted to carry ground signals, disadvantageous ground loops may also occur.

The possible necessity of shorting two or more contact pads of the device under test is also known. According to a known solution, known in the field as "loop-back", it is possible to short two contact pads of the device under test by means of the contact probes of the testing head, wherein a first probe carries a signal from a first pad of the device under test towards the test equipment and then the signal is closed on a second pad of the device under test by means of a second contact probe which contacts said second pad. In this case, however, the long path of the signal from the device under test to the test equipment and vice versa causes a reduction of the frequency performance of the testing head.

The need to improve the frequency performances of a testing head is therefore strongly felt in this technical field.

The technical problem of the present invention is to provide a testing head having structural and functional features such as to allow overcoming the limitations and drawbacks still affecting the known solutions, in particular able to reduce a simple way (and to eliminate in a simple way too) the interferences, and therefore the noise, caused by the presence of ground and power contact elements, as well as able to allow an electrical connection between contact pads of a device under test without reducing the frequency performances of the testing head itself.

Summary of the invention

The solution idea at the basis of the present invention is to provide a testing head wherein at least one guide is provided with guide holes for housing contact elements adapted to carry operating signals, i.e. input/output signals between a test equipment and a device under test, as well as contact elements adapted to carry ground and power signals, at least one group of the guide holes into which said ground contact elements are housed, and/or at least one group of the guide holes into which said power contact elements are housed, and/or at least one group of the guide holes into which said input/output contact elements are housed being electrically connected by a conductive portion made in the guide, said conductive portion forming a common conductive plane.

On the basis of this solution idea, the above-mentioned technical problem is solved by a testing head adapted to verify the operation of a device under test integrated on a semiconductor wafer, the testing head comprising at least one guide provided with a plurality of guide holes adapted to house a plurality of contact elements, each of the contact elements comprising a body that extends between a first end portion and a second end portion, such a testing head being characterized in that the at least one guide comprises at least one conductive portion that includes and electrically connects the holes of at least one group of the guide holes to each other and is adapted to contact a corresponding group of the contact elements, the contact elements of that corresponding group being adapted to carry a same type of signal.

More particularly, the invention comprises the following additional characteristics, taken individually or in combination if required.

According to an aspect of the present invention, the testing head can comprise at least one first conductive portion and at least one second conductive portion, the first conductive portion including and electrically connecting the holes of a first group of the guide holes to each other, such a first group housing first contact elements, the second conductive portion including and electrically connecting the holes of a second group of the guide holes to each other, such a second

group housing second contact elements.

In particular, the first contact elements housed in the first group of the guide holes can be adapted to carry ground signals, and the second contact elements housed in the second group of the guide holes can be adapted to carry power signals.

More in particular, one of the first and second conductive portion can be formed on a face of the at least one guide, and the other one of the first and second conductive portion can be formed on an opposite face of the at least one guide.

According to an aspect of the present invention, the at least one conductive portion can be separated from further conductive portions and/or can be locally interrupted by at least one non-conductive zone, so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

It is observed that the at least one guide can comprise at least one coating dielectric portion covering the at least one non-conductive zone.

Furthermore, the testing head can comprise at least one lower guide, at least one intermediate guide, and at least one upper guide, the lower guide and the intermediate guide being separated from each other by a first gap, the intermediate guide and the upper guide being separated from each other by a second gap, each of those guides comprising respective guide holes for the housing of the contact elements, one of the first and second conductive portion being formed on a face of the lower guide and the other one of the first and second conductive portion being formed on a face of the intermediate guide.

Alternatively, the testing head can comprise at least one lower guide, at least one intermediate guide, and at least one upper guide, the lower guide and the intermediate guide being separated from each other by a first gap, the intermediate guide and the upper guide being separated

from each other by a second gap, each of those guides comprising respective guide holes for the housing of the contact elements, both the lower guide and the intermediate guide comprising both the first conductive portion and the second conductive portion, the first conductive portion and the second conductive portion being physically and electrically separated from each other by a non-conductive zone of the guides.

In particular, in this case too, the first contact elements housed in the first group of the guide holes can be adapted to carry ground signals, and the second contact elements housed in the second group of the guide holes can be adapted to carry power signals.

Furthermore, the testing head can comprise at least one third conductive portion that includes and electrically connects the holes of a third group of the guide holes to each other, such a third group housing third contact elements. In particular, the third contact elements housed in the third group of the guide holes can be adapted to carry input/output signals between the device under test and a test equipment.

According to an aspect of the present invention, the at least one conductive portion can cover at least one portion of an inner surface of each guide hole of the group of guide holes.

According to another aspect of the present invention, the contact elements can be contact probes wherein the body has a deformation.

Alternatively, the contact elements can be pogo pins, the body comprising a casing and an elastic member arranged in the casing, the casing defining a first surface and a second surface, at least one of those surfaces being apt to abut onto the at least one guide, the electrical connection between the contact elements and the at least one conductive portion being a pressing contact through the first and/or second surface.

According to an aspect of the present invention, the at least one guide can comprise at least one common pad connected to the at least one conductive portion by means of a conductive track.

According to another aspect of the present invention, the at least one conductive portion can be arranged on a face of the at least one guide and can have a lower area than an area of the face of the at least one guide.

Alternatively, the at least one conductive portion can cover a face of the at least one guide, such a conductive portion electrically connecting the holes of the at least one of the guide holes to each other, with the exception of areas where guide holes not belonging to that at least one group are formed.

According to another aspect of the present invention, the at least one guide can comprise at least one further conductive portion, which includes one of the guide holes apt to house a single contact element, the at least one guide comprising a further common pad connected to the at least one further conductive portion by means of a further conductive track and/or comprising a conductive track that connects the at least one further conductive portion to other conductive portions.

It is also noted that the at least one conductive portion can be embedded in the at least one guide.

According to another aspect of the present invention, the at least one conductive portion can comprise a plurality of conductive portions overlapped to and electrically insulated from each other.

According to yet another aspect of the present invention, the testing head can comprise at least one conductive track that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of guide holes to each other and being adapted to contact respective groups of contact elements, the contact elements included in those respective groups

being adapted to carry a same type of signal.

Finally, the testing head can further comprise at least one circuit component, preferably a capacitor, which is electrically connected at least to the at least one conductive portion of the at least one guide.

The features and advantages of the testing head according to the invention will become apparent from the following description of an embodiment thereof, given by way of non-limiting example with reference to the accompanying drawings.

Brief description of the drawings

In those drawings:

- Figure 1 schematically shows a testing head according to the prior art;

- Figures 2A-2C schematically show a testing head according to different embodiments of the present invention;

- Figures 3A-3C schematically show a top view of a guide of the testing head of figures 2A-2C, respectively, whereas figure 3D schematically shows a top view of a guide of a testing head according to an alternative embodiment of the present invention;

- Figures 4A and 4B schematically show a testing head according to further alternative embodiments of the present invention;

- Figures 5A and 5B schematically show a portion of a testing head according to further alternative embodiments of the present invention;

- Figure 6 schematically shows a portion of a testing head according to yet another alternative embodiment of the present invention;

- Figure 7 schematically shows a testing head according to an alternative embodiment of the present invention, wherein contact elements are in the form of pogo pins;

- Figures 8A-8C schematically show top views of a guide of a testing head according to further alternative embodiments of the present invention;

- Figures 9A and 9B schematically show top views of a guide of a testing head according to further alternative embodiments of the present invention; and

- Figures 10A and 10B schematically show top views of a guide of a testing head according to yet further alternative embodiments of the present invention.

Detailed description

With reference to those figures, and in particular to the example of figure 2A, a testing head for testing electronic devices integrated on a semiconductor wafer according to the present invention is globally and schematically indicated with 20.

It is worth noting that the figures represent schematic views and are not drawn to scale, but instead they are drawn so as to emphasize the important features of the invention. Moreover, in the figures, the different elements are depicted in a schematic manner, their shape varying depending on the application desired. It is also noted that in the figures the same reference numbers refer to elements that are identical in shape or function. Finally, particular features described in relation to an embodiment illustrated in a figure are also applicable to the other embodiments illustrated in the other figures.

As shown in figure 2A, the testing head 20 comprises at least one guide 40 (a lower guide in the example of the figure) provided with a plurality of guide holes 40h adapted to house a plurality of contact elements. In particular, the guide holes 40h are adapted to house a plurality of first contact elements 21', which are apt to carry a first type of signal, a plurality of second contact elements 21", which are apt to carry a second type of signal, as well as a plurality of third contact elements

21'", which are apt to carry a third type of signal, as it will be described in greater detail hereinafter.

The guide 40 is made of a non-conductive material, for example a ceramic material such as silicon nitride, or of a glass or silicon-based material, or of a polyamide material, or of any other suitable dielectric material.

Generally, the testing head 20 is used to verify the operation of a device under which comprises at least one first region adapted to receive power and ground signals, and a second region adapted to receive/send input/output signals from/to a test equipment (not shown) connected to the testing head 20. In the first region, high current power signals, usually in the range of 1 A or higher, are handled, as well as ground signals, whereas in the second region operating signals, i.e. input/output signals having lower current values, usually in the range of 0,5 A or lower, are handled. For this reason, in the testing head 20 there are contact elements adapted to carry power and ground signals and contact elements adapted to carry input/output signals towards/from a device under test, those contact elements being distinct from each other and having different physical and mechanical characteristics.

At this regard, it is underlined that in the present disclosure the term "first contact elements" identifies the contact elements adapted to carry ground signals (reference number 21'), the term "second contact elements" identifies the contact elements adapted to carry power signals (reference number 21"), whereas the term "third contact elements" (reference number 21'") identifies the contact elements adapted to carry operating signals, i.e. input/output signals between the test equipment and the device under test, wherein this distinction does not limit the scope of the present invention.

For example, in the case of contact elements in the form of probes formed by metal wires, in the manufacturing of the first and second

contact elements 21' and 21" it is possible to use wires having different diameters, for example a larger diameter, compared to the diameter of the wires that form the third contact elements 21'"; it is possible to use also different materials for these different contact elements.

In the example of figure 2A, six contact elements are shown, in particular two first contact elements 21', two second contact elements 21" and two third contact elements 21'", but the number of those contact elements may obviously vary according to needs and/or circumstances, the figures being provided only for indicative purposes and not limiting the present invention.

Furthermore, again as a non-limiting example of the invention, figure 2A shows a testing head 20 wherein the contact elements are in the form of contact probes, preferably formed by metallic wires, having a body 21pr, which has a pre-deformation and is adapted to further deform upon the pressing contact with the contact pads of a device under test, said contact probes being housed in the guide holes 40h, which are formed in the single guide 40, but the invention is not limited to this and the testing head 20 can comprise a lower guide, an intermediate guide, and an upper guide, as well as a different kind of contact elements, as it will be illustrated in detail hereinafter.

Each contact element of the testing head 20 therefore comprises the body 21pr, which extends along a longitudinal axis H-H between a first end portion or contact tip 24 and a second end portion or contact head 25.

More in particular, the contact tip 24 is adapted to abut onto corresponding contact pads 26 of a device under test integrated in a semiconductor wafer 27.

Furthermore, in the illustrated example, the testing head 20 is a non-blocked-probe testing head and the contact elements terminate with the contact head 25 which is adapted to abut onto corresponding contact

pads 28 of an interposer or space transformer 29.

In particular, the space transformer 29 is apt to perform a spatial transformation of the distances between the pitches of the contact pads on opposite faces thereof, the space transformer 29 being generally connected to a printed circuit board or PCB (not shown), which is interfaced with the test equipment (also not shown).

Advantageously according to the present invention, the guide 40 comprises at least one first conductive portion 30' which includes a first group 40' of guide holes 40h. In other words, the first conductive portion 30' covers an area of the guide 40 which includes the first group 40' of the holes 40h, which are therefore formed at said area.

In particular, the guide holes of the first group 40' are electrically connected to each other by the first conductive portion 30' and house a corresponding group of contact elements, in particular a group of the first contact elements 21', and therefore house contact elements adapted to carry ground signals towards the device under test. In this way, the first conductive portion 30' forms a common conductive plane, in particular a ground plane, for the first contact elements 21' housed in the guide holes of the first group 40', said first contact elements 21' being therefore electrically connected to each other by means of the ground plane, with which they are all in contact.

In other words, in the testing head 20, the first contact elements 21', which are short-circuited among each other and are housed in the first group 40' of the guide holes 40h, are adapted to carry a same ground signal, resulting in the elimination of interferences on the operating signals and in an overall improvement of the frequency performance of the contact head 20.

As shown in figure 2A, the first conductive portion 30' is arranged on a superficial portion of the guide 40, in particular on a face FA thereof, said face FA being an upper face according to the local reference system

of figure 2A. The first conductive portion 30' may also be arranged on a face FB, opposite the face FA, of the guide 40, said face FB being a lower face according to the local reference system of figure 2A, or it may be arranged on both the faces FA and FB.

In the embodiment of figure 2A, as previously described, the first contact elements 21' of the testing head 20 are contact probes having the body 21pr provided with a pre-deformation and adapted to further deform itself during the contact with the contact pads 26 and 28 of the device under test and of the space transformer 29, respectively. In this case, the first conductive portion 30' preferably covers also at least one portion 40'W of an inner surface of each guide hole of the first group 40' of the guide holes 40h. More preferably, the internal surface of the guide holes of the first group 40' is entirely coated by the first conductive portion 30', the portion 40'W therefore coinciding with the entire inner surface of the holes. The electrical connection between the first contact probes 21' and the first conductive portion 30' is therefore achieved by means of a brushing contact between the body 21pr of the probes and the metallized portion 40'W of the guide holes into which the probes are housed.

However, it is underlined that also in the case in which the first conductive portion 30' does not coat the guide hole surface, the brushing contact is in any case guaranteed by the thickness of the first conductive portion 30' itself.

In an embodiment not shown in the figures, it is also possible to form the first conductive portion 30' in such a way that it is embedded in guide 40, in this way forming a ground plane which electrically connects the guide holes of the first group 40' within the guide 40. Obviously, such a first conductive portion 30' emerges at the inner surface of the guide holes in order to electrically contact the first contact probes 21'.

The presence of the first conductive portion 30', which allows to

electrically connect at least one group of the first contact elements 21' adapted to carry ground signals and therefore forming a common conductive (ground) plane, allows to eliminate the noise in the operating signals carried by the third contact elements 21'" inside the testing head 20.

In this way, the first conductive portion 30', by electrically connecting the holes of the first group 40' of the guide holes 40h to each other, short-circuits at least one corresponding group of the first contact elements 21', said group in particular being a group of ground contact elements.

In order to further reduce the noise, it is preferable that also the second contact elements 21", adapted to carry power signals, are electrically connected to each other, and as a consequence, in an embodiment represented in figure 2B, the guide 40 comprises at least one second conductive portion 30" which includes and electrically connects the holes of a second group 40" of the guide holes 40h to each other, wherein a corresponding group of the second contact elements 21" is housed in the second group 40", the second conductive portion 30" being physically separated from the first conductive portion 30' and therefore not electrically connected thereto. In this case, the second contact elements 21" connected by the second conductive portion 30", i.e. housed in the second group 40" of the guide holes 40h, are adapted to carry power signals and the second conductive portion 30" also forms a common conductive plane, in particular a power plane.

In this way, in the testing head 20, the second contact elements 21" housed in the second group 40" of the guide holes 40h are short-circuited to each other and are adapted to carry a same power signal.

As illustrated for the first conductive portion 30', the second conductive portion 30" is arranged on a superficial portion of guide 40 too, i.e. it is arranged on the face FA and/or on the face FB of the guide 40. Furthermore, also the second conductive portion 30" coats at least one

portion 40"W of an inner surface of each guide hole of the second group 40" of the guide holes 40h (preferably the entire surface), the electrical connection between the second contact elements 21" and the second conductive portion 30" being guaranteed by the brushing contact between the body 21pr of the second contact elements 21" and the portion 40"W coated by a conductive material (metallized).

It is appropriate to observe again that, in its more general form, the testing head 20 comprises contact elements adapted to carry ground and power signals, as well as contact elements adapted to carry operating signals, housed in the guides according to any kind of combination, the conductive portions being appropriately shaped so as to short-circuit even non-adjacent guide holes.

In an embodiment of the present invention shown in figure 2C, the guide 40 further comprises at least one third conductive portion 30'" which includes and electrically connects the holes of a third group 40'" of the guide holes 40h to each other, wherein a corresponding group of the third contact elements 21'" is housed in the third group 40'", the third conductive portion 30'" being physically separated from the first conductive portion 30' and from the second conductive portion 30" and therefore not electrically connected thereto. In this case, the third contact elements 21'" connected by the third conductive portion 30'", i.e. housed in the third group 40'" of the guide holes 40h, are adapted to carry operating signals, that is input/output signals between the device under test and the test equipment, and also the third conductive portion 30'" forms on a common conductive plane, in particular a signal plane.

In this way, in the testing head 20, the third contact elements 21'" housed in the third group 40'" of the guide holes 40h are short-circuited to each other and are adapted to carry a same operating signal, that is a same input/output signal between the device under test and the test equipment.

The embodiment of figure 2C is particularly advantageous in case of a necessity of short-circuiting two or more contact pads of the device under test, since it is possible to establish a loop-back configuration while considerably shortening the path of the signals, which do not pass through the entire contact element towards/from the test equipment but stop at the common conductive signal plane, with consequent advantages in terms of frequency performance of the testing head 20.

As illustrated for the first conductive portion 30' and the second conductive portion 30", the third conductive portion 30'" is arranged on a superficial portion of guide 40, that is it is arranged on the face FA and/or the face FB of guide 40. Furthermore, the third conductive portion 30'" coats at least one portion 40'"W of an inner surface of each guide hole of the third group 40'" of the guide holes 40h (preferably the entire surface), the electrical connection between the third contact elements 21'" and the third conductive portion 30'" being guaranteed by the brushing contact between the body 21pr of the third contact elements 21'" and the portion 40'"W coated with conductive material (metallized).

The conductive portions 30', 30" e 30'" are made of a metallic material for example selected from copper (Cu), silver (Ag), gold (Au), palladium (Pd), rhodium (Rh) and alloys thereof.

Obviously, even if not shown in the figures, it is possible to provide a configuration in which only the first conductive portion 30' is present, a configuration in which only the second conductive portion 30" is present, or a configuration in which only the third conductive portion 30'" is present, or any combination thereof.

Figure 3A shows a top view of guide 40, in particular of the face FA thereof, wherein the first conductive portion 30' electrically connects the holes of the first group 40' of the guide holes 40h, the first group 40' being adapted to house a corresponding group of the first contact elements 21' which carry ground signals, whereas figure 3B shows a top

view of the guide 40, still of the face FA thereof, wherein, in addition to the first conductive portion 30', also the second conductive portion 30" is formed, which electrically connects the holes of the second group 40" of the guide holes 40h, the second group 40" being adapted to house a corresponding group of the second contact elements 21" which carry power signals, and is physically and electrically separated from the first conductive portion 30' by a non-conductive zone 31 of guide 40. Similarly, figure 3C shows a top view of guide 40, still of the face FA thereof, wherein, in addition to the first conductive portion 30' and to the second conductive portion 30", also the third conductive portion 30"' is formed, which electrically connects the holes of the third group 40"' of the guide holes 40h, the third group 40"' being adapted to house a corresponding group of the third contact elements 21"' which carry input/output signals, and is physically and electrically separated from the conductive portions 30' and 30" by the non-conductive zone 31 of guide 40.

It is observed that the first conductive portion 30', the second conductive portion 30", and the third conductive portion 30"' only coat a superficial portion of guide 40, in particular only a portion of its face FA and/or its face FB, namely the first, the second and the third conductive portion 30', 30", 30"' do not extend over the entire area of the face FA and/or FB, so as to prevent contact elements that are not meant to be short-circuited from being short-circuited to each other. In other words, the conductive portions 30', 30", 30"' have an area that is less than an area of the face of the guide on which they are formed.

The guide 40 is therefore not entirely coated by the conductive portions 30', 30" and 30"', and at least the non-conductive zone 31, which separates the conductive portions, is present, the guide holes housing contact elements not meant to be short-circuited being formed in such a non-conductive zone 31.

Alternatively, in a further embodiment of the present invention shown in figure 3D, the first conductive portion 30' covers a face of the guide

40 (the face FA in the example), except for areas where guide holes adapted to house contact elements that must not be short-circuited are formed. In other words, the first conductive portion 30' is not formed in areas where the guide holes that do not belong to group 40' are formed. In this case, the non-conductive zone 31 is therefore formed only at the guide holes that do not belong to the first group 40'. It is underlined that, in this case, the non-conductive zone 31 may also be in the form of a plurality of non-conductive zones, each formed only at a guide hole that has to be electrically insulated. The same configuration can be adopted also for the second conductive portion 30" and for the third conductive portion 30'".

At this regard, it is possible to provide that the non-conductive zone 31 is covered by at least one added portion of dielectric material or coating dielectric portion arranged on guide 40, so as to avoid the presence of grooves in guide 40, for example between different conductive portions or at guide holes that don't have to be metallized, where metallic debris produced by the brushing contact of the contact elements with the walls of the guide holes may settle. In other words, the coating dielectric portion, which preferably has a thickness that is substantially equal to that of the conductive portions, coats the non-conductive zones 31 preventing metallic debris from settling therein, so as to avoid leakage and undesired electrical connections between contact elements adapted to carry a different kind of signal.

It is also possible that all the contact elements that carry a same kind of signal (for example all the input/output contact elements or all the ground or power contact elements) are electrically connected by means of one of the conductive portions 30', 30" and 30'", or that only some of them are connected by one of the conductive portions 30', 30" and 30'".

Furthermore, according to an alternative embodiment shown in figure 4A, the testing head 20 comprises at least one lower guide, still indicated with 40, at least one intermediate guide 41, and at least one upper guide 42. The lower guide 40 and the intermediate guide 41 are

separated from each other by a suitable first gap 32', whereas the intermediate guide 41 and the upper guide 42 are separated from each other by a suitable second gap 32".

It is preferable to form the conductive portions 30', 30" and 30'" in the lower guide 40 and/or in the intermediate guide 41 of the testing head 20, since in this way the conductive portions 30', 30" and 30'" are closer to the device under test.

In the embodiment of figure 4A, the intermediate guide 41 is provided with a plurality of guide holes 41h, adapted to house the contact elements 21', 21" and 21'".

Similarly, the upper guide 42 is provided with a plurality of guide holes 42h, adapted to house the contact elements 21', 21" and 21'".

Conveniently, also the intermediate guide 41 may comprise the first conductive portion 30', which includes and electrically connects the holes of a first group 41' of the guide holes 41h to each other, said first group 41' housing a corresponding group of the first contact elements 21', which carry ground signals. Furthermore, the intermediate guide 41 may also comprise the second conductive portion 30", which includes and electrically connects the holes of a second group 41" of guide holes 41h to each other, said second group 41" housing a correspondent group of the second contact elements 21", which carry power signals.

Similarly, also the intermediate guide 41 may comprise the third conductive portion 30'", which includes and electrically connects the holes of a third group 41'" of the guide holes 41h, said third group 41'" housing a corresponding group of the third contact elements 21'", which carry input/output signals.

In the example of figure 4A, which is provided for indicative purposes only and does not limit the scope of present invention, the first conductive portion 30' is arranged on a superficial portion of the

intermediate guide 41, in particular on a face FD thereof, said face FD being a lower face according to local reference system of figure 4A. The first conductive portion 30' may also be arranged on a face FC, opposite to the face FD, of the intermediate guide 41, said face FC being an upper face according to local reference system of figure 4A, or it may be arranged on both faces FC and FD. The conductive portions 30" and 30"' may be formed analogously.

As already observed for the lower guide 40, the conductive portions 30', 30" and 30"' only cover a superficial portion of the intermediate guide 41 as well, in particular only a portion of its face FC and/or its face FD, namely the conductive portions 30', 30" and 30"' do not extend over the entire area of the face FC and/or FD and therefore do not extend over the entire area of the intermediate guide 41.

Furthermore, in the example of figure 4A, the testing head 20 is manufactured according to the so-called "shifted plate technology", wherein the contact elements 21', 21" and 21"', are "buckling beam" contact probes and are initially formed straight, the relative shift of the guides causing a deformation of the probe body, as well as the desired retention of the probes itself thanks to the friction with the walls of the guide holes into which they slide.

In this case, as previously observed for the lower guide 40, also in the intermediate guide 41 the first conductive portion 30' coats at least one portion 41'W of an inner surface of each guide hole of the first group 41' of the guide holes 41h, the second conductive portion 30" coats at least one portion 41"W of an inner surface of each guide hole of the second group 41" of the guide holes 41h, and the third conductive portion 30"' coats at least one portion 41"'W of an inner surface of each guide hole of the third group 41"' of guide holes 41h, the electrical connection between the contact probes 21', 21" and 21"' and the conductive portions 30', 30" and 30"' being established by means of a brushing contact between the body 21pr of the contact probes and the metallized portions 41'W, 41"W and 41"'W, respectively.

It is possible to provide a configuration wherein only one between the lower guide 40 and the intermediate guide 41 comprises the first conductive portion 30' and/or the second conductive portion 30", or it is also possible to provide a configuration wherein both the lower guide 40 and the intermediate guide 41 comprise the first conductive portion 30' and/or the second conductive portion 30".

Figure 4A shows as an example an embodiment wherein both the lower guide 40 and the intermediate guide 41 comprise both the first conductive portion 30' and the second conductive portion 30". This embodiment also increases the possibility of a brushing contact between the contact probes and the conductive portions 30' and 30" and possibly the metallized portions 41'W and 41"W.

Still referring to figure 4A, it is possible to provide a configuration wherein both the intermediate guide 41 and the lower guide 40 comprise the third conductive portion 30'". Alternatively, it is possible to provide a configuration wherein only one between the intermediate guide 41 and the lower guide 40 comprises the third conductive portion 30'" which short-circuits input/output signal contact elements, preferably the lower guide 40.

In a preferred embodiment, schematically shown in figure 4B, the first conductive portion 30' is formed on one between the lower guide 40 and the intermediate guide 41, in particular the lower guide 40, and the second conductive portion 30" is formed on the other between the lower guide 40 and the intermediate guide 41, in particular the intermediate guide 41, in the illustrated example on two faces thereof facing each other, in particular the upper face FA of the lower guide 40 and the lower face FD of the intermediate guide 41, according to the local reference system of figure 4B. Obviously, in this embodiment as well one between the two guides 40 and 41, preferably the lower guide 40, may comprise the third conductive portion 30'". This embodiment simplifies the formation of the conductive portions 30', 30", 30" on different guides.

Obviously, for both the embodiment of figure 4A and the embodiment of figure 4B, it is possible to provide that also the upper guide 42 comprises the first conductive portion 30' and/or the second conductive portion 30" and/or the third conductive portion 30"', as well as it is also possible to provide a configuration wherein the intermediate guide 41 is not present but only the upper guide 42, on which the first conductive portion 30' and/or the second conductive portion 30" and/or the third conductive portion 30"' can be formed, is present.

In a particularly preferred embodiment of the present invention, shown in figures 5A and 5B, a same guide, in particular the lower guide 40 in the example of the figures, comprises the first conductive portion 30', which is formed on the face FA, and comprises the second conductive portion 30", which is formed on the opposite face FB. Analogous considerations can be made for the intermediate guide 41 and the faces FC and FD on which the first and/or second conductive portions 30' and 30" can be formed, and also for the upper guide 42.

It is observed that this embodiment, wherein the first conductive portion 30' and the second conductive portion 30" are formed on two opposite faces of the same guide, is particularly advantageous, since, as schematically shown in figure 5B, in many cases the first contact elements 21' (adapted to carry ground signals) and the second contact elements 21" (adapted to carry power signals) are very close to each other in the testing head 20, for example alternated one after the other, and for this reason it is complicated to form both conductive portions 30' and 30" on a same face of a guide of the testing head 20. In other words, in this embodiment, one of the first and second conductive portions 30' or 30" is adapted to electrically connect the first contact elements 21' (apt to carry ground signals), whereas the other conductive portion, formed on an opposite face of the same guide, is adapted to electrically connect the second contact elements 21" (apt to carry power signals), in particular alternated with the first contact elements 21', in this way simplifying the production of the testing head 20 and avoiding

complicated interlacement of conductive portions. If the first contact elements 21' adapted to carry ground signals and the second contact elements 21" adapted to carry power signals are alternated one after the other, both the conductive portions 30' and 30" are locally interrupted by suitable non-conductive zones 31' and 31" (similarly to what observed in relation to figures 3A-3D), respectively, so as to avoid an electrical connection between ground contact elements and power contact elements. The non-conductive zones 31' and 31" therefore locally prevent an electrical connection between adjacent contact elements apt to carry different signals.

Obviously, even if not shown in figures 5A and 5B, in this embodiment it is also possible to provide the presence, on one of the two faces of the guide, or even on both faces, of the third conductive portion 30"', the latter also possibly interrupted by suitable non-conductive zones if the third contact elements 21"' are very close, for example alternated, to the first contact elements 21' and/or the second contact elements 21".

According to a further alternative embodiment of the present invention illustrated in figure 6, one or more of the conductive portions 30', 30" and 30"' (the second conductive portion 30" in figure 6) comprises a plurality of conductive portions that are overlapped and electrically insulated from each other, said conductive portions being identified with the reference number 30"1-30"n in figure 6. In this case, a first layer 30"1 is formed on the face FA of guide 40, and the subsequent layers are formed starting from the first layer 30"1, consecutive conductive layers being separated from each other by a non-conductive layer 38". In this way, different conductive layers may form common conductive plans for different power (or ground or signal) domains, if needed by a particular application.

As an example, if the testing head 20 has to carry a plurality of different power signals (indicated in figure 6 as Vcc1 and Vcc2), in this embodiment the face FA of the guide 40 comprises a corresponding number of layers 30"1-30"n of the second conductive portion 30", each

layer being adapted to electrically connect the respective second contact elements 21" adapted to carry a single specific power signal. Furthermore, the other face of the guide, in the example the face FB, can be covered by the first conductive portion 30', which electrically connects the contact elements 21' adapted to carry ground signals. In this case too, each conductive layer may be locally interrupted by suitable non-conductive zones 31" in order to not electrically connect contact elements that must not be short-circuited to each other. In particular, the non-conductive zones 31" of a layer are formed at the holes housing contact elements that must not be short-circuited by said layer, whereas said layer covers at least partially the walls of the guide holes housing contact elements that must be short-circuited by it.

The conductive portions 30', 30" and 30"' may therefore be more than one, as there can be more than one power, ground and signal domains (the latter occurs when different groups of pads of the device under test need to be short-circuited), and possibly may be arranged on different levels if required.

As observed before, in figures 2A-2C, 4A-4B, 5A-5B and 6, the contact elements 21', 21" and 21"' are contact probes of the "buckling beam" type.

In a further alternative embodiment of the present invention, shown in figure 7, the contact elements of testing head 20 are in the form of pogo pins. In this embodiment, the testing head 20 comprises the lower guide 40 and the upper guide 42 and does not comprise the intermediate guide 41.

In particular, each contact element 21', 21" and 21"' comprises a body 21pp that includes a casing 33 and an elastic member 34 arranged inside the casing 33. A first end of the elastic member 34 is connected to a first end portion or contact tip 24 of the pogo pin, whereas a second end of the elastic element 34, opposite the first end, is connected to a second end portion or contact head 25 of the pogo pin. The contact tip

24, which is inserted into guide holes 40h formed in the lower guide 40, is adapted to abut onto contact pads 26 of a device under test integrated on a wafer 27, whereas the contact head 25, which is inserted into guide holes 42h formed in the upper guide 42, is adapted to abut onto contact pads 28 of a space transformer 29, the lower guide 40 and the upper guide 42 being separated by a gap 35.

The casing 33 of each pogo pin preferably has a cylindrical shape, but obviously other shapes are also possible.

Conveniently, the lower guide 40 and/or the upper guide 42 comprises the first conductive portion 30', which includes and electrically connects the holes of a first group 40' of the guide holes 40h to each other, and/or the holes of a first group 42' of guide holes 42h. Obviously, the lower guide 40 and/or the upper guide 42 may also comprise the second conductive portion 30", which includes and electrically connects the holes of a second group 40" of the guide holes 40h to each other, and/or the holes a second group 42" of guide holes 42h. The lower guide 40 and/or the upper guide 42 may also comprise the third conductive portion 30"', which includes and electrically connects the holes of a third group 40"' of guide holes 40h to each other, and/or the holes of a third group 42"' of the guide holes 42h, the third conductive portion 30"' being preferably formed on the lower guide 40.

The guide holes of the first group 40' and/or of the first group 42' house first contact elements or pogo pins 21' adapted to carry ground signals, the guide holes of the second group 40" and/or of the second group 42" house second contact elements or pogo pins 21" adapted to carry power signals, whereas the guide holes of the third group 40"' and/or the third group 42"' house third contact elements or pogo pin 21"' adapted to carry input/output signals between the device under test and the test equipment.

The casing 33 of the body 21pp of each pogo pin is shaped so as to

define a first surface S1 and a second surface S2, arranged at opposite ends of the casing 33 along a longitudinal axis H-H thereof, which surfaces S1 and S2 are adapted to abut onto the lower guide 40 and the upper guide 42, respectively, the casing 33 of the pogo pins having a maximum cross-sectional size (generally around 80 μm) that is greater than a diameter of the guide holes, the term diameter indicating a maximum cross-sectional size of the guide holes, even of non-circular section.

The contact tip 24 and the contact head 25 are electrically connected to the casing 33 of the pogo pins, said casing 33 being made of a conductive material.

In this way, the pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the first conductive portion 30' ensures the electrical connection between the first pogo pins 21' housed in the first group 40' and 42' of guide holes of the lower guide 40 and the upper guide 42, respectively, said pogo pins being adapted to carry ground signals, while the pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the second conductive portion 30" ensures the electrical connection between the second pogo pins 21" housed in the second group 40" and 42" of guide holes of the lower and upper guide 40 and 42, respectively, said pogo pins being adapted to carry power signals. Similarly, the pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the third conductive portion 30'" ensures the electrical connection between the third pogo pins 21'" housed in the third group 40'" and 42'" of guide holes of the lower and upper guides 40 and 42, respectively, said pogo pins being adapted to carry input/output operating signals.

In other words, the electrical connection between the pogo pins 21', 21" and 21'" and the conductive portions 30', 30" and 30'", respectively, is in this case performed by means of a pressing contact of the first surface S1 and the second surface S2 of the casing 33 on the lower

guide 40 and on the upper guide 42, respectively, the conductive portions being formed on a superficial portion of the lower guide 40, in particular on a face FA thereof, said face FA being an upper face according to the local reference system of figure 7, and/or on a face FE of the upper guide 42, said face FE being a lower face, still according to local reference system of figure 7.

The use of pogo pins as contact elements is particularly advantageous because in this case it is not necessary to guarantee a brushing contact between the contact elements and the inner surface of the guide holes, a pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the guides being sufficient to ensure the proper electrical connection between the conductive portions and the contact elements, wherein suitable groups of those contact elements are in this way electrically connected (short-circuited) to each other.

According to a further embodiment of the present invention, shown in figure 8A, the lower guide 40, which comprises the first conductive portion 30', comprises at least one first common pad 36' connected to the first conductive portion 30' by means of a first conductive track 37'. In this way, the first contact elements 21' adapted to carry ground signals are connected to the first common pad 36' by means of the first conductive track 37', the first common pad 36' therefore being a common ground pad. Even if figure 8A only shows the lower guide 40, also the intermediate guide 41 and/or the upper guide 42 may comprise a first common pad and a respective first conductive track.

The common pad 36' may be connected by means of a first connection wire to a housing (not shown) of the testing head 20.

Furthermore, as shown in figure 8B, the lower guide 40 and/or the intermediate guide 41 and/or the upper guide 42 (the lower guide 40 in the figure) may comprise at least one second common pad 36" connected to the second conductive portion 30" by means of a second conductive track 37". In this way, the second contact elements 21"

adapted to carry power signals are connected to the second common pad 36" by means of the second conductive track 37", the second common pad 36" therefore being a common power pad.

As shown in figure 8C, the lower guide 40 and/or the intermediate guide 41 and/or the upper guide 42 (the lower guide 40 in the figure) may also comprise at least one third common pad 36'" connected to the third conductive portion 30'" by means of a third conductive track 37'". In this way, the third contact elements 21'" adapted to carry input/output operating signals are connected to the third common pad 36'" by means of the third conductive track 37'", the third common pad 36'" therefore being a common signal pad.

The presence of a common pad 36', 36", 36'" connected to the respective conductive portion 30', 30", 30'" allows to extract a respective signal from the testing head 20 and to connect it, for example, to a PCB connected to the testing head 20. The common pad therefore can carry a monitoring signal, for example of the voltage levels on the corresponding guide.

As shown in figure 9A, it is also possible to provide the presence on a guide of a further conductive portion 30bis added to the conductive portions 30', 30" and 30'", the further conductive portion 30bis including and metallizing a single guide hole 40h, preferably housing a third contact element 21'" which carries input/output signals. In this case, the guide also comprises a further common pad 36bis connected to the further conductive portion 30bis by means of a further conductive track 37bis. In this way, the third contact element 21'" housed in such a metallized hole is electrically connected to the further common pad 36bis by means of the further conductive track 37bis, so that it is possible for example to transport an input/output signal from the further common pad 36bis towards a PCB. It is also possible to provide the presence of a plurality of further conductive portions, separated from each other, each performing the metallization of a respective single guide hole 40h, such further conductive portions being

possibly connected to each other by means of conductive tracks or by means of circuit components if needed.

Furthermore, according to an alternative embodiment of the present invention shown in figure 9B, it is possible to provide that at least two conductive portions (two first conductive portions 30' in figure 9B, but not limited to these) of the guide 40 are electrically connected to each other by means of a conductive track 39 in the guide, so as to be able to electrically connect to each other groups of contact elements adapted to carry a same type of signal but that are housed in respective groups of guide holes distanced from each other in the guide (two groups 40' in figure 9B but not limited to these).

Finally, according to an embodiment shown in figures 10A and 10B, the guide 40, which comprises at least one conductive portion (the conductive portion 30' in the figures but not limited thereto), also comprises at least one circuit component 50 connected to the conductive portion, which forms a common conductive plane.

In particular, in the example of figure 10A, the guide 40 comprises at least two conductive portions (two first conductive portions 30' in the figure but not limited thereto), the circuit component 50 being electrically connected thereto. As an example, the circuit component 50 is a filtering capacitor, still indicated with the reference number 50, having its rheophores 50r connected to respective conductive portions. The capacitor 50 is able to electrically connect to each other conductive portions that are apt to short-circuit contact elements adapted to carry ground, power, or input/output signals. Advantageously, such an embodiment allows to maximize the filtering effect of the capacitors 50, and therefore to reduce the interferences caused by contact elements that carry ground and power signals to a minimum, as well as to optimize the loop-back technique, since said capacitors 50 are thus positioned as close as possible to the contact tips of the contact elements (i.e. on the lower guide 40), namely close to the wafer 27.

Alternatively, as shown in figure 10B, it is also possible to provide a configuration wherein the capacitor 50 has a first rheophore 50r1 connected to a conductive portion which includes a plurality of guide holes (the conductive portion 30' in the figure but not limited to this) and the other rheophore 50r2 connected to a conductive portion that includes and metallizes a single guide hole.

The circuit component 50, which is preferably a filtering capacitor, may also be any other component suited for specific needs, as for example an inductor or a resistor or a relay, possibly housed in suitable housing seats formed in the guide. For example, it is possible connect a pair of inductors at two conductive portions (such as the two first conductive portions 30' in the figure but not limited to these) apt to be short-circuited in a loop-back configuration and to monitor the signal at those conductive portions.

In conclusion, the present invention provides a testing head wherein at least one guide comprises at least one conductive portion that includes and electrically connects to each other guide holes adapted to house contact elements carrying a same type of signal.

Advantageously according to the present invention, the contact elements that carry ground signals are therefore electrically connected in the testing head, preferably at the lower guide, which allows to considerably reduce (or even to completely eliminate) the signal noise generated by the different grounds, since the conductive portion of the guide forms a ground plane common to all the ground contact elements.

Similarly, also the electrical connection between the contact elements that carry power signals contributes to reducing interferences and therefore the noise in the testing head. In this way, advantageously according to the present invention, it is possible to reduce the common mode noise.

Consequently, the present invention allows an overall improvement of

the frequency performances of the testing head.

Furthermore, also the electrical connection between contact elements that carry operating signals (i.e. input/output signals), preferably at the lower guide, allows an increase of the frequency performances of the testing head in case there is a need to electrically connect two or more contact pads of the device under test.

Advantageously, it is possible to short-circuit groups of probes to each other (and therefore also the corresponding pads of the device), without transporting the relative signal of the test equipment, said short-circuit occurring at the lower and/or intermediate guide, i.e. close to the device under test, in this way improving the electrical performances of the short-circuit.

The possibility of short-circuiting the ground and power contact elements allows to improve also the current performances of the testing head of the present invention, also avoiding possible burning of the contact elements.

It is also possible to obtain a testing head with improved performances in terms of signal filtering, thanks to the presence of suitable circuit components, in particular capacitors electrically connected to the conductive portions.

Finally, the presence of a common pad allows to access to the contact elements directly from the housing of the testing head, such a common pad therefore replacing the plurality of contact pads and also allowing monitoring of the respective signals.

Obviously, a person skilled in the art, in order to meet particular needs and specifications, can carry out several changes and modifications to the testing head described above, all included in the protection scope of the invention as defined by the following claims.

CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h) adapted to house a plurality of contact elements (21', 21", 21'"), each of said contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), said testing head (20) being characterized in that said at least one guide (40, 41, 42) comprises at least one conductive portion (30', 30", 30'") that includes and electrically connects the holes of at least one group (40', 40"; 40'"; 41'; 41", 41'"; 42', 42", 42'") of said guide holes (40h, 41h, 42h) to each other and is apt to contact a corresponding group of said contact elements (21', 21", 21'"), said contact elements (21', 21", 21'") of said corresponding group being adapted to carry a same type of signal.

2. The testing head (20) according to claim 1, characterized in that it comprises at least one first conductive portion (30') and at least one second conductive portion (30"), said first conductive portion (30') including and electrically connecting the holes of a first group (40', 41', 42') of said guide holes (40h, 41h, 42h) to each other, said first group (40', 41', 42') housing first contact elements (21'), said second conductive portion (30") including and electrically connecting the holes of a second group (40", 41", 42") of said guide holes (40h, 41h, 42h) to each other, said second group (40", 41", 42") housing second contact elements (21").

3. The testing head (20) according to claim 2, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

4. The testing head (20) according to claim 2 or 3, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41, 42), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41, 42).

5. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

6. The testing head (20) according to claim 5, characterized in that said at least one guide (40, 41, 42) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

7. The testing head (20) according to claim 2, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

8. The testing head (20) according to claim 2, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said

intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"), said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

9. The testing head (20) according to claim 7 or 8, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

10. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30'") that includes and electrically connects the holes of a third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, said third group (40'", 41'", 42'") housing third contact elements (21'").

11. The testing head (20) according to claim 10, characterized in that said third contact elements (21'") housed in said third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) are adapted to carry input/output signals between the device under test and a test equipment.

12. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") covers at least one portion (40'W, 40"W , 40'"W; 41'W, 41"W, 41'"W) of an inner surface of each guide hole of said group (40', 40", 40'"; 41', 41", 41'") of said guide holes (40h, 41h).

13. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21'") are contact probes wherein said body (21pr) has a deformation.

14. The testing head (20) according to any one of the claims from 1 to 6, characterized in that said contact elements (21', 21", 21'") are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1, S2) being apt to abut onto said at least one guide (40, 42), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said first and/or second surface (S1, S2).

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

16. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42).

17. The testing head (20) according to any one of the claims from 1 to 15, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41, 42), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") are formed.

18. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h, 42h) apt to house a single contact element, said at least one guide (40, 41, 42) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

19. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30'") is embedded in said at least one guide (40, 41, 42).

20. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") comprises a plurality of conductive portions overlapped to and electrically insulated from each other.

21. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h, 42h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21'"), said contact elements included in said respective groups being adapted to carry a same type of signal.

22. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41, 42).

ABSTRACT

A testing head (20), adapted to verify the operation of a device under test integrated on a semiconductor wafer, comprises at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h) adapted to house a plurality of contact elements (21', 21", 21'"), each of the contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25). Conveniently, the at least one guide (40, 41, 42) comprises at least one conductive portion (30', 30", 30'") that includes and electrically connects the holes of at least one group (40', 40"; 40'"; 41'; 41", 41'"; 42', 42", 42'") of the guide holes (40h, 41h, 42h) to each other and is apt to contact a corresponding group of the contact elements (21', 21", 21'"), the contact elements (21', 21", 21'") of that corresponding group being adapted to carry a same type of signal.

(Figure 2A)

Europäisches Patentamt
European Patent Office
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Acknowledgement of receipt

We hereby acknowledge receipt of your request for the processing of an international application according to the Patent Cooperation Treaty as follows:

Submission number	5863180
PCT application number	PCT/EP2017/082180
Date of receipt	11 December 2017
Receiving Office	European Patent Office, The Hague
Your reference	TEC076BWO
Applicant	TECHNOPROBE S.p.A.
Number of applicants	1
Country	IT
Title	Testing head having improved frequency properties
Documents submitted	eolf-pkda.xml eolf-appb.xml eolf-vlog.xml eolf-abst.txt eolf-othd-000002.zip eolf-requ.xml eolf-fees.xml eolf-othd-000001.pdf (38 p.) eolf-appb-P000001.pdf (13 p.)
Submitted by	CN=Barbara Ferrari 6913
Method of submission	Online
Date and time receipt generated	11 December 2017, 12:21 (CET)

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Message Digest	4A:7B:CE:F5:56:C2:BB:FB:02:FE:18:1E:85:8D:4A:03:47:42:90:66

Correction by the EPO of errors in debit instructions filed by eOLF
Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82, OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

/European Patent Office/

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Ministero dello Sviluppo Economico
DIREZIONE GENERALE SVILUPPO PRODUTTIVO E COMPETITIVITA'-
UFFICIO ITALIANO BREVETTI E MARCHI

RAPPORTO DI RICERCA

Numero della domanda
IO 71490
IT 201700021389

DOCUMENTI CONSIDERATI DI RILIEVO

Categoria	Citazione del documento con indicazione, se appropriata, delle parti rilevanti	Rivendicazioni rilevanti	CLASSIFICAZIONE DELLA DOMANDA (IPC)
X	US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27) * paragraph [0019] - paragraph [0038]; figures 1-6 *	1-22	INV. G01R1/073
X	KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22) * the whole document *	1-22	
X	US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17) * paragraph [0024] - paragraph [0037]; figures 2-6 *	1-22	
X	WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09) * page 6 - page 17; figures 1-16 *	1-22	

CAMPI TECNICI RICERCATI (IPC)
G01R

Questo rapporto di ricerca è stato redatto sulla base di tutte le rivendicazioni

Munich	Data di completamento della ricerca: 11 January 2018	Esaminatore: Hijazi, Ali

CATEGORIA DEI DOCUMENTI CITATI

X : di particolare rilevanza se considerato singolarmente
Y : di particolare rilevanza se combinato con un altro documento della stessa categoria
A : informazione generica
O : divulgazione orale
P : documento intermedio

T : teoria o principio alla base dell'invenzione
E : documento brevettuale antecedente, ma pubblicato dopo o alla data di deposito
D : documento citato nella domanda
L : documento citato per altre ragioni
.....
& : membro della stessa famiglia di brevetti, documento corrispondente

EPO FORM 1503 07.08 (P04C74)

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ALLEGATO AL RAPPORTO DI RICERCA SULLA DOMANDA DI BREVETTO ITALIANO N.

IO 71490
IT 201700021389

Questo allegato enumera i membri della famiglia di brevetti relativi a documenti brevettuali citati nel summenzionato rapporto di ricerca.
I membri sono indicati come da database dell'Ufficio Europeo dei Brevetti al 11-01-2018
L'Ufficio Europeo dei Brevetti non si assume alcuna responsabilità per queste indicazioni, che vengono fornite a solo scopo informativo.

Documenti brevettuali citati nel rapporto di ricerca	Data di pubblicazione	Membri della famiglia di brevetti	Data di pubblicazione
US 2012242360 A1	27-09-2012	SG 184681 A1	30-10-2012
		TW 201239365 A	01-10-2012
		US 2012242360 A1	27-09-2012
KR 101421051 B1	22-07-2014	NONE	
US 2014197860 A1	17-07-2014	NONE	
WO 2012106220 A1	09-08-2012	JP 6157047 B2	05-07-2017
		JP 2012159422 A	23-08-2012
		TW 201246727 A	16-11-2012
		WO 2012106220 A1	09-08-2012

EPO FORM P04A3

Per ulteriori dettagli riguardanti questo allegato, si veda la Gazzetta Ufficiale (OJ) dell'Ufficio Europeo dei Brevetti, N. 12/82

Ministero dello Sviluppo Economico

DIREZIONE GENERALE SVILUPPO PRODUTTIVO E COMPETITIVITA' -
UFFICIO ITALIANO BREVETTI E MARCHI

OPINIONE SCRITTA

N. dossier	Data di deposito *(gg/mm/aa)*	Data di priorità *(gg/mm/aa)*	N. domanda
IO71490	24.02.2017		IT201700021389

Classificazione Internazionale dei Brevetti (IPC)
INV. G01R1/073

Richiedente
TECHNOPROBE S.P.A.

Questa opinione fornisce indicazioni riguardanti i seguenti elementi:

- ☒ Riquadro N. I — Base dell'opinione
- ☐ Riquadro N. II — Priorità
- ☐ Riquadro N. III — Non-redazione di un'opinione a riguardo di novità, attività inventiva e applicazione industriale
- ☐ Riquadro N. IV — Violazione del requisito d'unità dell'invenzione
- ☒ Riquadro N. V — Dichiarazione motivata a riguardo di novità, attività inventiva o applicazione industriale; citazioni e spiegazioni giustificative della dichiarazione
- ☐ Riquadro N. VI — Particolari documenti citati
- ☒ Riquadro N. VII — Difetti particolari nella domanda
- ☒ Riquadro N. VIII — Osservazioni particolari a riguardo della domanda

	Esaminatore
	Hijazi, Ali

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N. domanda

OPINIONE SCRITTA

IT201700021389

Riquadro N. I Base dell'opinione

1. Questa opinione è stata redatta sulla base delle ultime rivendicazioni depositate prima dell'inizio della ricerca nella tecnica anteriore.

2. Per quanto concerne eventuali sequenze di nucleotidi e/o amminoacidi descritte nella domanda e necessarie per l'invenzione di cui oggetto nelle rivendicazioni, questa opinione è stata redatta sulla base di:

   a. tipo di materiale:

   ☐ una sequenza di DNA

   ☐ una o più tabelle relative alla sequenza di DNA

   b. formato del materiale:

   ☐ cartaceo

   ☐ elettronico

   c. momento di deposito o presentazione:

   ☐ depositato insieme alla domanda al momento del deposito della medesima

   ☐ depositato insieme alla domanda in formato elettronico

   ☐ presentato successivamente al fine della ricerca d'anteriorità

3. ☐ Inoltre, ove sia stata depositata o presentata più di una versione o copia di una sequenza di DNA e/o tabella ad essa relativa, è stata presentata anche la dichiarazione obbligatoria che le informazioni contenute nelle copie successive o addizionali sono identiche a quelle nella domanda come depositata o che, in ogni caso, non vanno oltre il contenuto della domanda depositata originariamente.

4. Note aggiuntive:

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OPINIONE SCRITTA

Riquadro N. VDichiarazione motivata a riguardo di novità, attività inventiva o applicazione industriale; citazioni e spiegazioni giustificative della dichiarazione

1. 1. Dichiarazione

Novità (N)	Sì:	Rivendicazioni	2-4, 6-22
	No:	Rivendicazioni	1, 5
Attività inventiva (IS)	Sì:	Rivendicazioni	
	No:	Rivendicazioni	1-22
Applicazione industriale (IA)	Sì:	Rivendicazioni	1-22
	No:	Rivendicazioni	

2. 2. Citazioni e spiegazioni

si veda l'allegato

Riquadro N. VII Difetti particolari nella domanda

si veda l'allegato

Riquadro N. VIII Osservazioni particolari a riguardo della domanda

si veda l'allegato

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27)

D2 KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22)

D3 US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17)

D4 WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09)

2 Novelty, inventive step.

2.1 Independent claim 1.

2.1.1 D1 discloses:

A testing head (Figs. 2A, 2B, 3) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (22, 24) provided with a plurality of guide holes (26, 28) adapted to house a plurality of contact elements (32, 34), each of said contact elements comprising a body that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one conductive portion (202, 204) that includes and electrically connects the holes of at least one group of said guide holes to each other (see paragraph 0027 in relation with layer 202) and is apt to contact a corresponding group of said contact elements (the metal probes 34), said contact elements of said corresponding group being adapted to carry a same type of signal.

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2.1.2 D2 discloses:

A testing head (Figs. 3, 4) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (11, 12) provided with a plurality of guide holes (11b, 11b', 12b, 12b') adapted to house a plurality of contact elements (20), each of said contact elements comprising a body (30) that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one conductive portion (40a, 40b) that includes and electrically connects the holes of at least one group of said guide holes to each other (see Fig. 4, corresponding to G connection) and is apt to contact a corresponding group of said contact elements, said contact elements of said corresponding group being adapted to carry a same type of signal (G).

2.1.3 D3 discloses:

A testing head (Figs. 3-5) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (30) provided with a plurality of guide holes (36) adapted to house a plurality of contact elements (22), each of said contact elements comprising a body that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one conductive portion (40, 52, 54) that includes and electrically connects the holes of at least one group of said guide holes to each other (see Fig. 4) and is apt to contact a corresponding group of said contact elements, said contact elements of said corresponding group being adapted to carry a same type of signal (paragraph 0008, the aim is to divert current from a single probe).

2.1.4 D4 is directed to a socket for an IC device and therefore the arrangement of Fig. 4 appears suitable to test an IC being still on a wafer. D4 appears to disclose also all the other features of claim 1, see the segmentation done in Figs. 4, 5 for instance and as explained for instance on page 8, last paragraph.

2.1.5 The subject-matter of claim 1 is therefore not new in view of any of D1 to D4.

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2.2 The structure of the set of claims is such that a high number of combinations are claimed and therefore it is not possible to do an analysis of all possibilities. Some of their additional features are known from the cited documents, see for instance claim 5 in e.g. D1 or some other aspects do not appear involve an inventive step (see for instance claim 22). At present it appears therefore that none of the claims are patentable as none of these claims would be novel or involve an inventive step in view of the cited prior art.

3 All the claims are related to a testing head and therefore the claimed invention is considered to be industrially applicable.

Re Item VII

Certain defects in the application

4 D1 to D4 and the relevant background are not acknowledged in the description. The two-part form is not in line with what is known from any one of D1 to D4.

Re Item VIII

Certain observations on the application

5 The following claims are not clear.

5.1 Claim 1.

5.1.1 From the chosen wording it is not clear whether the contact elements are part or not of the claimed testing head.

5.1.2 It appears not to be very clear how a conductive portion can be in electrical contact with a hole, as presently claimed at lines 10-12.

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5.2 Claim 3. The subject-matter of claim 2 relates to the use of the testing head and is therefore not clear. Without having information on the use of the testing head it is not possible to clearly distinguish the contact elements (assuming they are part of the testing head, see above).

5.3 A similar objection applies to the subject-matter of claim 11.

5.4 Claim 13. It is stated that the body "has a deformation", however it is not stated compared to what or under which circumstances so that this feature is not clear either.

6 The last paragraph of the description is of speculative nature and should be deleted. The same applies to the last sentence of paragraph 0045 on page 9/30.

7 Due to poor quality drawings, new pages were received for the search. It is not clear however if this was a scan problem or if new drawings have been submitted and therefore it could not be examined whether these drawings are extending or not the scope of the application as originally filed.

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PATENT COOPERATION TREATY

From the RECEIVING OFFICE

PCT

To:

Ferrari, Barbara
BOTTI & FERRARI S.R.L.
Via Cappellini, 11
I-20124 Milano
ITALIE

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.2(c))

Date of mailing *(day/month/year)*	18.01.2018
Applicant's or agent's file reference TEC076BWO	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2017/082180	11 December 2017 (11-12-2017)	16 December 2016 (16-12-2016)

Applicant

TECHNOPROBE S.P.A.

Title of the invention

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

[X] was transmitted to the International Bureau on **see above date of mailing**

[ ] has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:

[ ] because the necessary national security clearance has not yet been obtained

[ ] because *(reason to be specified)*

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

Name and mailing address of the Receiving Office	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	Prouteau, Evelyne

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PCT REQUEST

Print Out (Original in Electronic Form)

0	**For receiving Office use only**	
0-1	International Application No.	**PCT/EP2017/082180**
0-2	International Filing Date	**11 DEC 2017 (11.12.2017)**
0-3	Name of receiving Office and "PCT International Application"	**RO/EP**

0-4	**Form PCT/RO/101 PCT Request**	
0-4-1	Prepared Using	PCT Online Filing Version 3.5.000.251e MT/FOP 20141031/0.20.5.20
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	European Patent Office (EPO) (RO/EP)
0-7	**Applicant's or agent's file reference**	TEC076BWO
I	**Title of Invention**	Testing head having improved frequency properties
II	**Applicant**	
II-1	This person is	Applicant only
II-2	Applicant for	All designated States
II-4	Name	TECHNOPROBE S.p.A.
II-5	Address	Via Cavalieri di Vittorio Veneto, 2 23870 Cernusco Lombardone (Lecco) Italy
II-6	State of nationality	IT
II-7	State of residence	IT
III-1	**Applicant and/or inventor**	
III-1-1	This person is	Inventor only
III-1-3	Inventor for	All designated States
III-1-4	Name (LAST, First)	MAGGIONI, Flavio
III-1-5	Address	c/o TECHNOPROBE S.p.A. Via Cavalieri di Vittorio Veneto, 2 23870 Cernusco Lombardone (Lecco) Italy

PCT REQUEST

Print Out (Original in Electronic Form)

IV-1	**Agent or common representative; or address for correspondence**	
	The person identified below is hereby/ has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	Agent
IV-1-1	Name (LAST, First)	FERRARI, Barbara
IV-1-2	Address	BOTTI & FERRARI S.r.l. Via Cappellini, 11 20124 Milano Italy
IV-1-3	Telephone No.	+39 02 6704275
IV-1-4	Facsimile No.	+39 02 6703250
V	**DESIGNATIONS**	
V-1	**The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.**	
VI-1	**Priority claim of earlier national application**	
VI-1-1	Filing date	16 December 2016 (16.12.2016)
VI-1-2	Number	102016000127581
VI-1-3	Country or Member of WTO	IT
VI-2	**Priority claim of earlier national application**	
VI-2-1	Filing date	24 February 2017 (24.02.2017)
VI-2-2	Number	102017000021389
VI-2-3	Country or Member of WTO	IT
VI-3	**Incorporation by reference :**	
	where an element of the international application referred to in Article 11(1)(iii)(d) or (e) or a part of the description, claims or drawings referred to in Rule 20.5(a) is not otherwise contained in this international application but is completely contained in an earlier application whose priority is claimed on the date on which one or more elements referred to in Article 11(1)(iii) were first received by the receiving Office, that element or part is, subject to confirmation under Rule 20.6, incorporated by reference in this international application for the purposes of Rule 20.6.	
VII-1	**International Searching Authority Chosen**	European Patent Office (EPO) (ISA/EP)

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VII-2	**Request to use results of earlier search; reference to that search**	
VII-2-1	Filing date	16 December 2016 (16.12.2016)
VII-2-2	Application Number	102016000127581
VII-2-3	Country (or regional Office)	IT
VII-2-5	Documents are available to the ISA in a form and manner acceptable to it and therefore do not need to be submitted by the applicant to the ISA (Rule 12bis.1(f)):	A copy of the results of the earlier search A copy of the earlier application A copy of any document cited in the results of the earlier search
VII-3	**Request to use results of earlier search; reference to that search**	
VII-3-1	Filing date	24 February 2017 (24.02.2017)
VII-3-2	Application Number	102017000021389
VII-3-3	Country (or regional Office)	IT
VII-3-4	Statement (Rule 4.12(ii)):	This international application is the same, or substantially the same, as the application in respect of which the earlier search was carried out except, where applicable, that it is filed in a different language.
VII-3-5	Documents are available to the ISA in a form and manner acceptable to it and therefore do not need to be submitted by the applicant to the ISA (Rule 12bis.1(f)):	A copy of the results of the earlier search A copy of the earlier application A copy of any document cited in the results of the earlier search

VIII	**Declarations**	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	–	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	–	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	–	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	–	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	–	

PCT REQUEST

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IX	Check list	Number of sheets	Electronic file(s) attached
IX-1	Request (including declaration sheets)	4	✓
IX-2	Description	32	✓
IX-3	Claims	5	✓
IX-4	Abstract	1	✓
IX-5	Drawings	13	✓
IX-7	TOTAL	55	
	Accompanying Items	Paper document(s) attached	Electronic file(s) attached
IX-8	Fee calculation sheet	–	✓
IX-19	Other	Pre-conversion archive	✓
IX-20	**Figure of the drawings which should accompany the abstract**	2A	
IX-21	**Language of filing of the international application**	English	
X-1	**Signature of applicant, agent or common representative**	(PKCS7 Digital Signature)	
X-1-1	Name (LAST, First)	FERRARI, Barbara	
X-1-3	Capacity (if such capacity is not obvious from reading the request)	(Representative)	

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	11 DEC 2017 (11.12.2017)
10-2	**Drawings:**	✓
10-2-1	Received	
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	
10-4	**Date of timely receipt of the required corrections under PCT Article 11(2)**	
10-5	**International Searching Authority**	ISA/EP
10-6	**Transmittal of search copy delayed until search fee is paid**	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	**Date of receipt of the record copy by the International Bureau**	

PCT

POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCT Rule 90.4)

The undersigned applicant(s) *(Names should be indicated as they appear in the request)*:

TECHNOPROBE S.p.A.
Via Cavalieri di Vittorio Veneto, 2
I-23870 Cernusco Lombardone (Lecco)
Italy

hereby appoints (appoint) the following person as: ☒ agent ☐ common representative

Name and address
(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

BOTTI Mario-FERRECCIO Rinaldo-ZAMBARDINO Umberto-FERRARI Barbara-GERLI Paolo-ZELIOLI Giovanni-ANTONUCCI Emanuele
BOTTI & FERRARI S.r.l.
Via Cappellini, 11
I-20124 MILANO
Italy

to represent the undersigned before

☒ all the competent International Authorities
☐ the International Searching Authority only
☐ the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: Testing head having improved frequency properties

Applicant's or agent's file reference: TEC076BWO

International application number (if already available): PCT/EP2017/082180

filed with the following Office European Patent Office as receiving Office
and to make or receive payments on behalf of the undersigned.

Signature of the applicant(s) *(where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power)*:

TECHNOPROBE S.p.A.

Date: 12/01/2018

GIUSEPPE CRIPPA
PRESIDENT

Form PCT/Model of power of attorney (for a given international application) (July 1992)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Letter accompanying subsequently filed items under the Patent Cooperation Treaty (PCT) - Online filing

The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

1. General information

Filing Office and capacity	Application number
RO/EP	PCT/EP2017/082180
International filing date	**(Earliest) Priority date**
2017-12-11	2016-12-16

Title of the invention

Testing head having improved frequency properties

2. Reference number

TEC076BWO

3. Attached documents

Document type/content	Language	No. of sheets	Original file name
Power of Attorney			
1) Power of attorney	English	1	TEC076BWO-power of attorney.pdf

4. Fees (EUR)

Total amount 0.00

5. Method of payment

Not applicable

6. Note(s) for EPO

7. Signature(s)

Digitally signed by: Subject: Barbara Ferrari 6913; Issuer: European Patent Office, European Patent Office CA G2
Date: 06 February 2018
Capacity: Representative

Patentlaan 2, NL 2288, HV Rijswijk, The Netherlands
Tel: +31 70 340 4500, Fax: +31 70 340 4600
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Europäisches Patentamt
European Patent Office
Office européen des brevets

Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	6027367	
Application number	PCT/EP2017/082180	
Date of receipt	06 February 2018	
Filing Office / capacity	European Patent Office, The Hague	RO
Your reference	TEC076BWO	
Applicant	All applicants as on file	
Documents submitted	package-data.xml pct-sfd-fee-sheet.xml ROPOAT-1.pdf (1 p.)	pct-sfd-request.xml pct-sfd.pdf (1 p.)
Submitted by	CN=Barbara Ferrari 6913	
Method of submission	Online	
Date and time receipt generated	06 February 2018, 14:59 (CET)	
Message Digest	0A:F7:26:12:7C:19:6A:F8:3F:8C:E0:03:16:FD:99:8F:B7:3E:88:A5	

Correction by the EPO of errors in debit instructions filed by eOLF
Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged according to point 6.3 ff ADA, Supplement to OJ EPO 3/2014 (see decision T 152/82, OJ EPO 1984, 301).

/European Patent Office/

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Copy for (RO-EP) 32
PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION RELATING TO
DECLARATION MADE UNDER PCT RULE 4.17

(PCT Rules 26*ter* and 48.2(a)(x)
and Administrative Instructions, Section 419)

To:

FERRARI, Barbara
BOTTI & FERRARI S.r.l.
Via Cappellini, 11
20124 Milano
ITALIE

Date of mailing *(day/month/year)* 09 February 2018 (09.02.2018)	
Applicant's or agent's file reference TEC076BWO	**IMPORTANT NOTIFICATION**
International application No. PCT/EP2017/082180	International filing date *(day/month/year)* 11 December 2017 (11.12.2017)
Applicant TECHNOPROBE S.P.A.	

1. The applicant is hereby **notified** of the following regarding the declaration indicated below in respect of MAGGIONI, Flavio :

   (i) ☐ declaration as to the identity of the inventor (Rules 4.17(i) and 51*bis*.1(a)(i) and Section 211)

   (ii) ☐ declaration as to the applicant's entitlement, as at the international filing date, to apply for or be granted a patent (Rules 4.17(ii) and 51*bis*.1(a)(ii) and Section 212)

   (iii) ☐ declaration as to the applicant's entitlement, as at the international filing date, to claim priority of the earlier application (Rules 4.17(iii) and 51*bis*.1(a)(iii) and Section 213)

   (iv) ☒ declaration of inventorship (for the purposes of the designation of the United States of America) (Rules 4.17(iv) and 51*bis*.1(a)(iv) and Section 214)

   (v) ☐ declaration as to non-prejudicial disclosures or exceptions to lack of novelty (Rules 4.17(v) and 51*bis*.1(a)(v) and Section 215)

2. ☒ **Addition or correction of the declaration within the time limit under Rule 26*ter*.1.**

   The added or corrected declaration was received on 08 February 2018 (08.02.2018) , which was within the time limit under Rule 26*ter*.1.

   Any declaration referred to under items 1(i) to (v), whether or not the declaration complies with Rule 4.17, will be published as part of the international application pursuant to Rule 48.2(a)(x).

3. ☐ **Failure to add or correct the declaration within the time limit under Rule 26*ter*.1.**

   The declaration was received on which was **after** the expiration of the time limit under Rule 26*ter*.1; therefore, that declaration, as added or corrected, referred to under items 1(i) to (v) will **not** be published as part of the international application, and any signed declaration referred to under item 1(iv) is attached. **Such declaration should be submitted by the applicant directly to the designated Office(s) concerned.**

4. The applicant's attention is drawn to Rule 51*bis*.2 which provides that the designated Office shall not, unless it may reasonably doubt the veracity of the declaration concerned, require any document or evidence relating to the subject matter of any declaration complying with Rule 4.17(i) to (iv) which is contained in the request or submitted to the International Bureau or directly to the designated Office. Note, however, that Rule 51*bis*.2 may not apply in respect of certain States. For further information, see Notes to the request form, Box No. VIII.

5. A copy of this notification is being sent to the receiving Office and the International Searching Authority.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 89 75	Authorized officer Poupel Sylvie e-mail pct.team5@wipo.int Telephone No. +41 22 338 74 05

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27)

D2 KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22)

D3 US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17)

D4 WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09)

2 Novelty, inventive step.

2.1 Independent claim 1.

2.1.1 D1 discloses:

A testing head (Figs. 2A, 2B, 3) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (22, 24) provided with a plurality of guide holes (26, 28) adapted to house a plurality of contact elements (32, 34), each of said contact elements comprising a body that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one conductive portion (202, 204) that includes and electrically connects the holes of at least one group of said guide holes to each other (see paragraph 0027 in relation with layer 202) and is apt to contact a corresponding group of said contact elements (the metal probes 34), said contact elements of said corresponding group being adapted to carry a same type of signal.

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2.1.2 D2 discloses:

A testing head (Figs. 3, 4) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (11, 12) provided with a plurality of guide holes (11b, 11b', 12b, 12b') adapted to house a plurality of contact elements (20), each of said contact elements comprising a body (30) that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one conductive portion (40a, 40b) that includes and electrically connects the holes of at least one group of said guide holes to each other (see Fig. 4, corresponding to G connection) and is apt to contact a corresponding group of said contact elements, said contact elements of said corresponding group being adapted to carry a same type of signal (G).

2.1.3 D3 discloses:

A testing head (Figs. 3-5) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (30) provided with a plurality of guide holes (36) adapted to house a plurality of contact elements (22), each of said contact elements comprising a body that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one conductive portion (40, 52, 54) that includes and electrically connects the holes of at least one group of said guide holes to each other (see Fig. 4) and is apt to contact a corresponding group of said contact elements, said contact elements of said corresponding group being adapted to carry a same type of signal (paragraph 0008, the aim is to divert current from a single probe).

2.1.4 D4 is directed to a socket for an IC device and therefore the arrangement of Fig. 4 appears suitable to test an IC being still on a wafer. D4 appears to disclose also all the other features of claim 1, see the segmentation done in Figs. 4, 5 for instance and as explained for instance on page 8, last paragraph.

2.1.5 The subject-matter of claim 1 is therefore not new in view of any of D1 to D4 (Article 33(2) PCT).

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2.2 The structure of the set of claims is such that a high number of combinations are claimed and therefore it is not possible to do an analysis of all possibilities. Some of their additional features are known from the cited documents, see for instance claim 5 in e.g. D1 or some other aspects do not appear involve an inventive step (see for instance claim 22). At present it appears therefore that none of the claims are patentable as none of these claims would be novel or involve an inventive step in view of the cited prior art.

3 All the claims are related to a testing head and therefore the claimed invention is considered to be industrially applicable (Article 33(4) PCT).

Re Item VII

Certain defects in the application

4 D1 to D4 and the relevant background are not acknowledged in the description (Rule 5.1(a)(ii) PCT). The two-part form is not in line with what is known from any one of D1 to D4 (Rule 6.3(b) PCT).

Re Item VIII

Certain observations on the application

5 The following claims are not clear (Article 6 PCT).

5.1 Claim 1.

5.1.1 From the chosen wording it is not clear whether the contact elements are part or not of the claimed testing head.

5.1.2 It appears not to be very clear how a conductive portion can be in electrical contact with a hole, as presently claimed at line 12.

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5.2 Claim 3. The subject-matter of claim 3 relates to the use of the testing head and is therefore not clear. In addition, without having information on the use of the testing head (for instance which values of power signal are considered) it is not possible to clearly distinguish the contact elements from any prior art or between themselves (assuming they are part of the testing head, see above).

5.3 A similar objection applies to the subject-matter of claim 11.

5.4 Claim 13. It is stated that the body "has a deformation", however it is not stated compared to what or under which circumstances so that this feature is not clear either.

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2017/082180	11.12.2017	16.12.2016

International Patent Classification (IPC) or both national classification and IPC
INV. G01R1/073

Applicant
TECHNOPROBE S P A

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Hijazi, Ali Telephone No. +49 89 2399-0

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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

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Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2-4, 6-22
	No:	Claims	1, 5
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-22
Industrial applicability (IA)	Yes:	Claims	1-22
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 June 2018 (21.06.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/108790 A1

(51) International Patent Classification:
G01R 1/073 (2006.01)

(21) International Application Number:
PCT/EP2017/082180

(22) International Filing Date:
11 December 2017 (11.12.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
102016000127581 16 December 2016 (16.12.2016) IT
102017000021389 24 February 2017 (24.02.2017) IT

(71) Applicant: **TECHNOPROBE S.P.A.** [IT/IT]; Via Cavalieri di Vittorio Veneto, 2, 23870 Cernusco Lombardone (Lecco) (IT).

(72) Inventor: **MAGGIONI, Flavio**; c/o TECHNOPROBE S.p.A., Via Cavalieri di Vittorio Veneto, 2, 23870 Cernusco Lombardone (Lecco) (IT).

(74) Agent: **FERRARI, Barbara**; BOTTI & FERRARI S.r.l., Via Cappellini, 11, 20124 Milano (IT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: TESTING HEAD HAVING IMPROVED FREQUENCY PROPERTIES

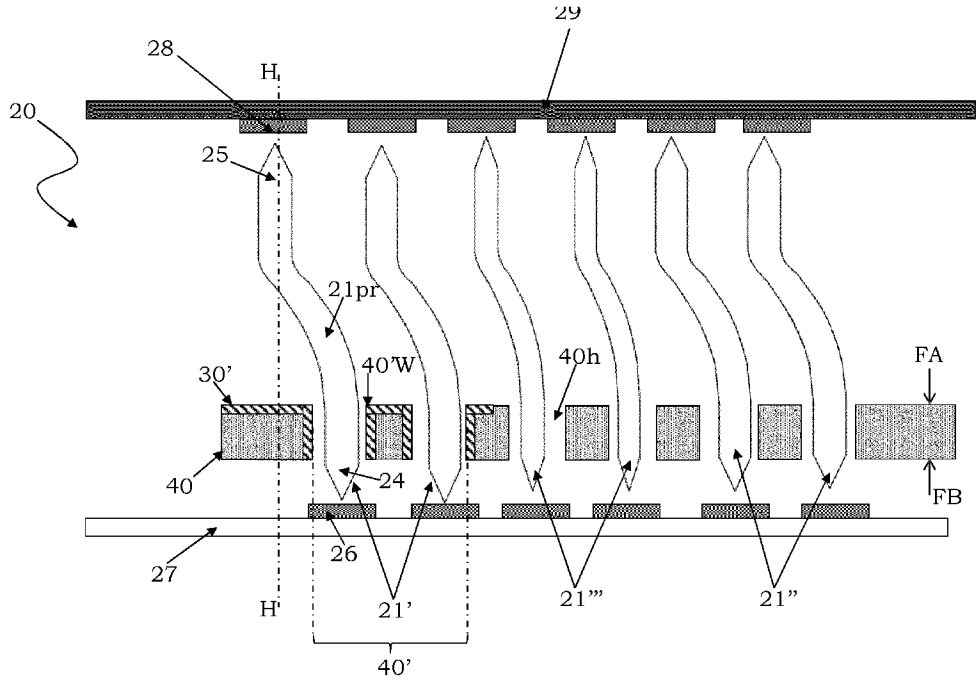


FIG. 2A

(57) Abstract: A testing head (20), adapted to verify the operation of a device under test integrated on a semiconductor wafer, comprises at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h) adapted to house a plurality of contact elements (21', 21", 21'"), each of the contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25). Conveniently, the at least one guide (40, 41, 42) comprises at least one conductive portion (30', 30", 30'") that includes and electrically connects the holes of at least one group (40', 40"; 40'"; 41'; 41", 41'"; 42', 42", 42'") of the guide holes (40h, 41h, 42h) to each other and is apt to contact a corresponding group of the contact elements (21', 21", 21'"), the contact elements (21', 21", 21'") of that corresponding group being adapted to carry a same type of signal.

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[Continued on next page]

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(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Title: "Testing head having improved frequency properties"

DESCRIPTION

Field of application

The present invention relates to a testing head for testing electronic devices integrated on a semiconductor substrate. More in particular, the present invention relates to a testing head comprising at least one guide provided with a plurality of guide holes adapted to house a plurality of contact elements, and the following description is made with reference to this application field with the only purpose of simplifying the exposition.

Prior art

As it is well known, a testing head (probe head) is essentially a device adapted to place a plurality of contact pads of a microstructure, such as an electronic device integrated on a wafer, into electrical contact with corresponding channels of a testing machine performing the working test thereof, in particular the electrical one, or generically the test.

The test, which is performed on integrated devices, is particularly useful to detect and isolate defective devices yet in the manufacturing step. Generally, the testing heads are thus used to electrically test the devices that are integrated on a wafer before cutting and assembling them inside a chip containing package.

Generally, a testing head comprises a plurality of contact elements or contact probes retained by at least one guide or by at least one pair of guides (or supports) which are substantially plate-shaped and parallel to each other. Those guides are provided with suitable holes and are arranged at a certain distance from each other so as to leave a free space or air gap for the movement and the possible deformation of the contact probes, which are slidingly housed in those guide holes. The

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pair of guides comprises in particular an upper guide and a lower guide, both provided with respective guide holes where the contact probes axially slide, the probes being usually made of wires of special alloys having good electrical and mechanical properties.

The good connection between the contact probes and the contact pads of the device under test is guaranteed by pressing the testing head on the device itself, the contact probes undergoing a bending inside the air gap between the guides and a sliding within the respective guide holes during that pressing contact. Testing heads of this kind are usually called "vertical probe head".

Substantially, the vertical probe testing heads have a gap in which the bending of the contact probes occurs, the bending being possibly assisted by means of a suitable configuration of the probes themselves or of their guides, as schematically shown in Figure 1.

In particular, figure 1 schematically shows a testing head 1 comprising at least one upper guide 2, usually indicated as “upper die”, and a lower guide 3, usually indicated as “lower die”, separated by a gap 13, having respective guide holes 4 and 5 in which a plurality of contact probes 6 slides, only one probe of the plurality of contact probes being shown in figure 1 for the sake of simplicity.

Each contact probe 6 terminates at an end with a contact tip 7 adapted to abut onto a contact pad 8 of a device under test integrated on a wafer 9, in order to carry out the mechanical and electrical contact between the device under test and a test equipment (not shown) of which such a testing head is a terminal element.

Here and hereinafter, the term “contact tip” indicates an end zone or region of a contact probe adapted to contact a contact pad of the device under test, such an end zone or region not necessarily being sharp.

In some cases, the contact probes are fixedly fastened to the testing head at the upper guide: in such cases, the testing heads are referred to as “blocked probe testing heads”.

More frequently, testing heads having probes not fixedly fastened are used, those probes being interfaced to a board, possibly by means of a micro-contact board: those testing heads are referred to as “non-blocked probe testing heads”. The micro-contact board is usually called "space transformer" since, besides contacting the probes, it also allows to spatially redistribute the contact pads made on it with respect to the contact pads of the device to be tested, in particular relaxing the distance constraints between the centers of the pads themselves.

In this case, as shown in figure 1, each contact probe 6 has a further end zone or region which terminates with a so-called contact head 10 towards a contact pad 11 of a plurality of contact pads of a space transformer 12. The good electrical contact between probes 6 and space transformer 12 is ensured by the pressing contact of the testing heads 10 of the contact probes 6 on the contact pads 11 of the space transformer 12, analogously to the contact between the contact tips 7 and the contact pads 8 of the device under test integrated on the wafer 9.

Contact elements in the form of pogo pins are also known in the art, the pogo pins essentially comprising an elastic body connected to two end portions, the elastic body compressing upon contact of the end portions with the contact pads of the device under test and of the space transformer.

Generally, inside a testing head, the contact elements are divided into contact elements adapted to carry power and ground signals towards the device under test, and into contact elements adapted to carry operating signals, in particular input/output signals, between the test equipment and the device under test.

In the case of a testing head of the kind described above, it is well known that the presence of several contact elements adapted to carry ground signals, as well as the presence of contact elements adapted to carry power signals, creates interferences, therefore causing noise in the input/output signals used for the test of the device under test, which limits the frequency performance of the testing head. In the case of contact elements adapted to carry ground signals, disadvantageous ground loops may also occur.

The possible necessity of shorting two or more contact pads of the device under test is also known. According to a known solution, known in the field as "loop-back", it is possible to short two contact pads of the device under test by means of the contact probes of the testing head, wherein a first probe carries a signal from a first pad of the device under test towards the test equipment and then the signal is closed on a second pad of the device under test by means of a second contact probe which contacts said second pad. In this case, however, the long path of the signal from the device under test to the test equipment and vice versa causes a reduction of the frequency performance of the testing head.

The need to improve the frequency performances of a testing head is therefore strongly felt in this technical field.

The technical problem of the present invention is to provide a testing head having structural and functional features such as to allow overcoming the limitations and drawbacks still affecting the known solutions, in particular able to reduce a simple way (and to eliminate in a simple way too) the interferences, and therefore the noise, caused by the presence of ground and power contact elements, as well as able to allow an electrical connection between contact pads of a device under test without reducing the frequency performances of the testing head itself.

Summary of the invention

The solution idea at the basis of the present invention is to provide a testing head wherein at least one guide is provided with guide holes for housing contact elements adapted to carry operating signals, i.e. input/output signals between a test equipment and a device under test, as well as contact elements adapted to carry ground and power signals, at least one group of the guide holes into which said ground contact elements are housed, and/or at least one group of the guide holes into which said power contact elements are housed, and/or at least one group of the guide holes into which said input/output contact elements are housed being electrically connected by a conductive portion made in the guide, said conductive portion forming a common conductive plane.

On the basis of this solution idea, the above-mentioned technical problem is solved by a testing head adapted to verify the operation of a device under test integrated on a semiconductor wafer, the testing head comprising at least one guide provided with a plurality of guide holes adapted to house a plurality of contact elements, each of the contact elements comprising a body that extends between a first end portion and a second end portion, such a testing head being characterized in that the at least one guide comprises at least one conductive portion that includes and electrically connects the holes of at least one group of the guide holes to each other and is adapted to contact a corresponding group of the contact elements, the contact elements of that corresponding group being adapted to carry a same type of signal.

More particularly, the invention comprises the following additional characteristics, taken individually or in combination if required.

According to an aspect of the present invention, the testing head can comprise at least one first conductive portion and at least one second conductive portion, the first conductive portion including and electrically connecting the holes of a first group of the guide holes to each other, such a first group housing first contact elements, the second conductive portion including and electrically connecting the holes of a second group of the guide holes to each other, such a second

group housing second contact elements.

In particular, the first contact elements housed in the first group of the guide holes can be adapted to carry ground signals, and the second contact elements housed in the second group of the guide holes can be adapted to carry power signals.

More in particular, one of the first and second conductive portion can be formed on a face of the at least one guide, and the other one of the first and second conductive portion can be formed on an opposite face of the at least one guide.

According to an aspect of the present invention, the at least one conductive portion can be separated from further conductive portions and/or can be locally interrupted by at least one non-conductive zone, so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

It is observed that the at least one guide can comprise at least one coating dielectric portion covering the at least one non-conductive zone.

Furthermore, the testing head can comprise at least one lower guide, at least one intermediate guide, and at least one upper guide, the lower guide and the intermediate guide being separated from each other by a first gap, the intermediate guide and the upper guide being separated from each other by a second gap, each of those guides comprising respective guide holes for the housing of the contact elements, one of the first and second conductive portion being formed on a face of the lower guide and the other one of the first and second conductive portion being formed on a face of the intermediate guide.

Alternatively, the testing head can comprise at least one lower guide, at least one intermediate guide, and at least one upper guide, the lower guide and the intermediate guide being separated from each other by a first gap, the intermediate guide and the upper guide being separated

from each other by a second gap, each of those guides comprising respective guide holes for the housing of the contact elements, both the lower guide and the intermediate guide comprising both the first conductive portion and the second conductive portion, the first conductive portion and the second conductive portion being physically and electrically separated from each other by a non-conductive zone of the guides.

In particular, in this case too, the first contact elements housed in the first group of the guide holes can be adapted to carry ground signals, and the second contact elements housed in the second group of the guide holes can be adapted to carry power signals.

Furthermore, the testing head can comprise at least one third conductive portion that includes and electrically connects the holes of a third group of the guide holes to each other, such a third group housing third contact elements. In particular, the third contact elements housed in the third group of the guide holes can be adapted to carry input/output signals between the device under test and a test equipment.

According to an aspect of the present invention, the at least one conductive portion can cover at least one portion of an inner surface of each guide hole of the group of guide holes.

According to another aspect of the present invention, the contact elements can be contact probes wherein the body has a deformation.

Alternatively, the contact elements can be pogo pins, the body comprising a casing and an elastic member arranged in the casing, the casing defining a first surface and a second surface, at least one of those surfaces being apt to abut onto the at least one guide, the electrical connection between the contact elements and the at least one conductive portion being a pressing contact through the first and/or second surface.

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According to an aspect of the present invention, the at least one guide can comprise at least one common pad connected to the at least one conductive portion by means of a conductive track.

According to another aspect of the present invention, the at least one conductive portion can be arranged on a face of the at least one guide and can have a lower area than an area of the face of the at least one guide.

Alternatively, the at least one conductive portion can cover a face of the at least one guide, such a conductive portion electrically connecting the holes of the at least one of the guide holes to each other, with the exception of areas where guide holes not belonging to that at least one group are formed.

According to another aspect of the present invention, the at least one guide can comprise at least one further conductive portion, which includes one of the guide holes apt to house a single contact element, the at least one guide comprising a further common pad connected to the at least one further conductive portion by means of a further conductive track and/or comprising a conductive track that connects the at least one further conductive portion to other conductive portions.

It is also noted that the at least one conductive portion can be embedded in the at least one guide.

According to another aspect of the present invention, the at least one conductive portion can comprise a plurality of conductive portions overlapped to and electrically insulated from each other.

According to yet another aspect of the present invention, the testing head can comprise at least one conductive track that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of guide holes to each other and being adapted to contact respective groups of contact elements, the contact elements included in those respective groups

being adapted to carry a same type of signal.

Finally, the testing head can further comprise at least one circuit component, preferably a capacitor, which is electrically connected at least to the at least one conductive portion of the at least one guide.

The features and advantages of the testing head according to the invention will become apparent from the following description of an embodiment thereof, given by way of non-limiting example with reference to the accompanying drawings.

Brief description of the drawings

In those drawings:

- Figure 1 schematically shows a testing head according to the prior art;

- Figures 2A-2C schematically show a testing head according to different embodiments of the present invention;

- Figures 3A-3C schematically show a top view of a guide of the testing head of figures 2A-2C, respectively, whereas figure 3D schematically shows a top view of a guide of a testing head according to an alternative embodiment of the present invention;

- Figures 4A and 4B schematically show a testing head according to further alternative embodiments of the present invention;

- Figures 5A and 5B schematically show a portion of a testing head according to further alternative embodiments of the present invention;

- Figure 6 schematically shows a portion of a testing head according to yet another alternative embodiment of the present invention;

- Figure 7 schematically shows a testing head according to an alternative embodiment of the present invention, wherein contact elements are in the form of pogo pins;

- Figures 8A-8C schematically show top views of a guide of a testing head according to further alternative embodiments of the present invention;

- Figures 9A and 9B schematically show top views of a guide of a testing head according to further alternative embodiments of the present invention; and

- Figures 10A and 10B schematically show top views of a guide of a testing head according to yet further alternative embodiments of the present invention.

Detailed description

With reference to those figures, and in particular to the example of figure 2A, a testing head for testing electronic devices integrated on a semiconductor wafer according to the present invention is globally and schematically indicated with 20.

It is worth noting that the figures represent schematic views and are not drawn to scale, but instead they are drawn so as to emphasize the important features of the invention. Moreover, in the figures, the different elements are depicted in a schematic manner, their shape varying depending on the application desired. It is also noted that in the figures the same reference numbers refer to elements that are identical in shape or function. Finally, particular features described in relation to an embodiment illustrated in a figure are also applicable to the other embodiments illustrated in the other figures.

As shown in figure 2A, the testing head 20 comprises at least one guide 40 (a lower guide in the example of the figure) provided with a plurality of guide holes 40h adapted to house a plurality of contact elements. In particular, the guide holes 40h are adapted to house a plurality of first contact elements 21', which are apt to carry a first type of signal, a plurality of second contact elements 21", which are apt to carry a second type of signal, as well as a plurality of third contact elements

21'", which are apt to carry a third type of signal, as it will be described in greater detail hereinafter.

The guide 40 is made of a non-conductive material, for example a ceramic material such as silicon nitride, or of a glass or silicon-based material, or of a polyamide material, or of any other suitable dielectric material.

Generally, the testing head 20 is used to verify the operation of a device under which comprises at least one first region adapted to receive power and ground signals, and a second region adapted to receive/send input/output signals from/to a test equipment (not shown) connected to the testing head 20. In the first region, high current power signals, usually in the range of 1 A or higher, are handled, as well as ground signals, whereas in the second region operating signals, i.e. input/output signals having lower current values, usually in the range of 0,5 A or lower, are handled. For this reason, in the testing head 20 there are contact elements adapted to carry power and ground signals and contact elements adapted to carry input/output signals towards/from a device under test, those contact elements being distinct from each other and having different physical and mechanical characteristics.

At this regard, it is underlined that in the present disclosure the term "first contact elements" identifies the contact elements adapted to carry ground signals (reference number 21'), the term "second contact elements" identifies the contact elements adapted to carry power signals (reference number 21"), whereas the term "third contact elements" (reference number 21'") identifies the contact elements adapted to carry operating signals, i.e. input/output signals between the test equipment and the device under test, wherein this distinction does not limit the scope of the present invention.

For example, in the case of contact elements in the form of probes formed by metal wires, in the manufacturing of the first and second

contact elements 21' and 21" it is possible to use wires having different diameters, for example a larger diameter, compared to the diameter of the wires that form the third contact elements 21'"; it is possible to use also different materials for these different contact elements.

In the example of figure 2A, six contact elements are shown, in particular two first contact elements 21', two second contact elements 21" and two third contact elements 21'", but the number of those contact elements may obviously vary according to needs and/or circumstances, the figures being provided only for indicative purposes and not limiting the present invention.

Furthermore, again as a non-limiting example of the invention, figure 2A shows a testing head 20 wherein the contact elements are in the form of contact probes, preferably formed by metallic wires, having a body 21pr, which has a pre-deformation and is adapted to further deform upon the pressing contact with the contact pads of a device under test, said contact probes being housed in the guide holes 40h, which are formed in the single guide 40, but the invention is not limited to this and the testing head 20 can comprise a lower guide, an intermediate guide, and an upper guide, as well as a different kind of contact elements, as it will be illustrated in detail hereinafter.

Each contact element of the testing head 20 therefore comprises the body 21pr, which extends along a longitudinal axis H-H between a first end portion or contact tip 24 and a second end portion or contact head 25.

More in particular, the contact tip 24 is adapted to abut onto corresponding contact pads 26 of a device under test integrated in a semiconductor wafer 27.

Furthermore, in the illustrated example, the testing head 20 is a non-blocked-probe testing head and the contact elements terminate with the contact head 25 which is adapted to abut onto corresponding contact

pads 28 of an interposer or space transformer 29.

In particular, the space transformer 29 is apt to perform a spatial transformation of the distances between the pitches of the contact pads on opposite faces thereof, the space transformer 29 being generally connected to a printed circuit board or PCB (not shown), which is interfaced with the test equipment (also not shown).

Advantageously according to the present invention, the guide 40 comprises at least one first conductive portion 30' which includes a first group 40' of guide holes 40h. In other words, the first conductive portion 30' covers an area of the guide 40 which includes the first group 40' of the holes 40h, which are therefore formed at said area.

In particular, the guide holes of the first group 40' are electrically connected to each other by the first conductive portion 30' and house a corresponding group of contact elements, in particular a group of the first contact elements 21', and therefore house contact elements adapted to carry ground signals towards the device under test. In this way, the first conductive portion 30' forms a common conductive plane, in particular a ground plane, for the first contact elements 21' housed in the guide holes of the first group 40', said first contact elements 21' being therefore electrically connected to each other by means of the ground plane, with which they are all in contact.

In other words, in the testing head 20, the first contact elements 21', which are short-circuited among each other and are housed in the first group 40' of the guide holes 40h, are adapted to carry a same ground signal, resulting in the elimination of interferences on the operating signals and in an overall improvement of the frequency performance of the contact head 20.

As shown in figure 2A, the first conductive portion 30' is arranged on a superficial portion of the guide 40, in particular on a face FA thereof, said face FA being an upper face according to the local reference system

of figure 2A. The first conductive portion 30' may also be arranged on a face FB, opposite the face FA, of the guide 40, said face FB being a lower face according to the local reference system of figure 2A, or it may be arranged on both the faces FA and FB.

In the embodiment of figure 2A, as previously described, the first contact elements 21' of the testing head 20 are contact probes having the body 21pr provided with a pre-deformation and adapted to further deform itself during the contact with the contact pads 26 and 28 of the device under test and of the space transformer 29, respectively. In this case, the first conductive portion 30' preferably covers also at least one portion 40'W of an inner surface of each guide hole of the first group 40' of the guide holes 40h. More preferably, the internal surface of the guide holes of the first group 40' is entirely coated by the first conductive portion 30', the portion 40'W therefore coinciding with the entire inner surface of the holes. The electrical connection between the first contact probes 21' and the first conductive portion 30' is therefore achieved by means of a brushing contact between the body 21pr of the probes and the metallized portion 40'W of the guide holes into which the probes are housed.

However, it is underlined that also in the case in which the first conductive portion 30' does not coat the guide hole surface, the brushing contact is in any case guaranteed by the thickness of the first conductive portion 30' itself.

In an embodiment not shown in the figures, it is also possible to form the first conductive portion 30' in such a way that it is embedded in guide 40, in this way forming a ground plane which electrically connects the guide holes of the first group 40' within the guide 40. Obviously, such a first conductive portion 30' emerges at the inner surface of the guide holes in order to electrically contact the first contact probes 21'.

The presence of the first conductive portion 30', which allows to

electrically connect at least one group of the first contact elements 21' adapted to carry ground signals and therefore forming a common conductive (ground) plane, allows to eliminate the noise in the operating signals carried by the third contact elements 21''' inside the testing head 20.

In this way, the first conductive portion 30', by electrically connecting the holes of the first group 40' of the guide holes 40h to each other, short-circuits at least one corresponding group of the first contact elements 21', said group in particular being a group of ground contact elements.

In order to further reduce the noise, it is preferable that also the second contact elements 21", adapted to carry power signals, are electrically connected to each other, and as a consequence, in an embodiment represented in figure 2B, the guide 40 comprises at least one second conductive portion 30" which includes and electrically connects the holes of a second group 40" of the guide holes 40h to each other, wherein a corresponding group of the second contact elements 21" is housed in the second group 40", the second conductive portion 30" being physically separated from the first conductive portion 30' and therefore not electrically connected thereto. In this case, the second contact elements 21" connected by the second conductive portion 30", i.e. housed in the second group 40" of the guide holes 40h, are adapted to carry power signals and the second conductive portion 30" also forms a common conductive plane, in particular a power plane.

In this way, in the testing head 20, the second contact elements 21" housed in the second group 40" of the guide holes 40h are short-circuited to each other and are adapted to carry a same power signal.

As illustrated for the first conductive portion 30', the second conductive portion 30" is arranged on a superficial portion of guide 40 too, i.e. it is arranged on the face FA and/or on the face FB of the guide 40. Furthermore, also the second conductive portion 30" coats at least one

portion 40"W of an inner surface of each guide hole of the second group 40" of the guide holes 40h (preferably the entire surface), the electrical connection between the second contact elements 21" and the second conductive portion 30" being guaranteed by the brushing contact between the body 21pr of the second contact elements 21" and the portion 40"W coated by a conductive material (metallized).

It is appropriate to observe again that, in its more general form, the testing head 20 comprises contact elements adapted to carry ground and power signals, as well as contact elements adapted to carry operating signals, housed in the guides according to any kind of combination, the conductive portions being appropriately shaped so as to short-circuit even non-adjacent guide holes.

In an embodiment of the present invention shown in figure 2C, the guide 40 further comprises at least one third conductive portion 30'" which includes and electrically connects the holes of a third group 40'" of the guide holes 40h to each other, wherein a corresponding group of the third contact elements 21'" is housed in the third group 40'", the third conductive portion 30'" being physically separated from the first conductive portion 30' and from the second conductive portion 30" and therefore not electrically connected thereto. In this case, the third contact elements 21'" connected by the third conductive portion 30'", i.e. housed in the third group 40'" of the guide holes 40h, are adapted to carry operating signals, that is input/output signals between the device under test and the test equipment, and also the third conductive portion 30'" forms on a common conductive plane, in particular a signal plane.

In this way, in the testing head 20, the third contact elements 21'" housed in the third group 40'" of the guide holes 40h are short-circuited to each other and are adapted to carry a same operating signal, that is a same input/output signal between the device under test and the test equipment.

The embodiment of figure 2C is particularly advantageous in case of a necessity of short-circuiting two or more contact pads of the device under test, since it is possible to establish a loop-back configuration while considerably shortening the path of the signals, which do not pass through the entire contact element towards/from the test equipment but stop at the common conductive signal plane, with consequent advantages in terms of frequency performance of the testing head 20.

As illustrated for the first conductive portion 30' and the second conductive portion 30", the third conductive portion 30'" is arranged on a superficial portion of guide 40, that is it is arranged on the face FA and/or the face FB of guide 40. Furthermore, the third conductive portion 30'" coats at least one portion 40'"W of an inner surface of each guide hole of the third group 40'" of the guide holes 40h (preferably the entire surface), the electrical connection between the third contact elements 21'" and the third conductive portion 30'" being guaranteed by the brushing contact between the body 21pr of the third contact elements 21'" and the portion 40'"W coated with conductive material (metallized).

The conductive portions 30', 30" e 30'" are made of a metallic material for example selected from copper (Cu), silver (Ag), gold (Au), palladium (Pd), rhodium (Rh) and alloys thereof.

Obviously, even if not shown in the figures, it is possible to provide a configuration in which only the first conductive portion 30' is present, a configuration in which only the second conductive portion 30" is present, or a configuration in which only the third conductive portion 30'" is present, or any combination thereof.

Figure 3A shows a top view of guide 40, in particular of the face FA thereof, wherein the first conductive portion 30' electrically connects the holes of the first group 40' of the guide holes 40h, the first group 40' being adapted to house a corresponding group of the first contact elements 21' which carry ground signals, whereas figure 3B shows a top

view of the guide 40, still of the face FA thereof, wherein, in addition to the first conductive portion 30', also the second conductive portion 30" is formed, which electrically connects the holes of the second group 40" of the guide holes 40h, the second group 40" being adapted to house a corresponding group of the second contact elements 21" which carry power signals, and is physically and electrically separated from the first conductive portion 30' by a non-conductive zone 31 of guide 40. Similarly, figure 3C shows a top view of guide 40, still of the face FA thereof, wherein, in addition to the first conductive portion 30' and to the second conductive portion 30", also the third conductive portion 30"' is formed, which electrically connects the holes of the third group 40"' of the guide holes 40h, the third group 40"' being adapted to house a corresponding group of the third contact elements 21"' which carry input/output signals, and is physically and electrically separated from the conductive portions 30' and 30" by the non-conductive zone 31 of guide 40.

It is observed that the first conductive portion 30', the second conductive portion 30", and the third conductive portion 30"' only coat a superficial portion of guide 40, in particular only a portion of its face FA and/or its face FB, namely the first, the second and the third conductive portion 30', 30", 30"' do not extend over the entire area of the face FA and/or FB, so as to prevent contact elements that are not meant to be short-circuited from being short-circuited to each other. In other words, the conductive portions 30', 30", 30"' have an area that is less than an area of the face of the guide on which they are formed.

The guide 40 is therefore not entirely coated by the conductive portions 30', 30" and 30"', and at least the non-conductive zone 31, which separates the conductive portions, is present, the guide holes housing contact elements not meant to be short-circuited being formed in such a non-conductive zone 31.

Alternatively, in a further embodiment of the present invention shown in figure 3D, the first conductive portion 30' covers a face of the guide

40 (the face FA in the example), except for areas where guide holes adapted to house contact elements that must not be short-circuited are formed. In other words, the first conductive portion 30' is not formed in areas where the guide holes that do not belong to group 40' are formed. In this case, the non-conductive zone 31 is therefore formed only at the guide holes that do not belong to the first group 40'. It is underlined that, in this case, the non-conductive zone 31 may also be in the form of a plurality of non-conductive zones, each formed only at a guide hole that has to be electrically insulated. The same configuration can be adopted also for the second conductive portion 30" and for the third conductive portion 30'".

At this regard, it is possible to provide that the non-conductive zone 31 is covered by at least one added portion of dielectric material or coating dielectric portion arranged on guide 40, so as to avoid the presence of grooves in guide 40, for example between different conductive portions or at guide holes that don't have to be metallized, where metallic debris produced by the brushing contact of the contact elements with the walls of the guide holes may settle. In other words, the coating dielectric portion, which preferably has a thickness that is substantially equal to that of the conductive portions, coats the non-conductive zones 31 preventing metallic debris from settling therein, so as to avoid leakage and undesired electrical connections between contact elements adapted to carry a different kind of signal.

It is also possible that all the contact elements that carry a same kind of signal (for example all the input/output contact elements or all the ground or power contact elements) are electrically connected by means of one of the conductive portions 30', 30" and 30'", or that only some of them are connected by one of the conductive portions 30', 30" and 30'".

Furthermore, according to an alternative embodiment shown in figure 4A, the testing head 20 comprises at least one lower guide, still indicated with 40, at least one intermediate guide 41, and at least one upper guide 42. The lower guide 40 and the intermediate guide 41 are

separated from each other by a suitable first gap 32', whereas the intermediate guide 41 and the upper guide 42 are separated from each other by a suitable second gap 32".

It is preferable to form the conductive portions 30', 30" and 30'" in the lower guide 40 and/or in the intermediate guide 41 of the testing head 20, since in this way the conductive portions 30', 30" and 30'" are closer to the device under test.

In the embodiment of figure 4A, the intermediate guide 41 is provided with a plurality of guide holes 41h, adapted to house the contact elements 21', 21" and 21'".

Similarly, the upper guide 42 is provided with a plurality of guide holes 42h, adapted to house the contact elements 21', 21" and 21'".

Conveniently, also the intermediate guide 41 may comprise the first conductive portion 30', which includes and electrically connects the holes of a first group 41' of the guide holes 41h to each other, said first group 41' housing a corresponding group of the first contact elements 21', which carry ground signals. Furthermore, the intermediate guide 41 may also comprise the second conductive portion 30", which includes and electrically connects the holes of a second group 41" of guide holes 41h to each other, said second group 41" housing a correspondent group of the second contact elements 21", which carry power signals.

Similarly, also the intermediate guide 41 may comprise the third conductive portion 30'", which includes and electrically connects the holes of a third group 41'" of the guide holes 41h, said third group 41'" housing a corresponding group of the third contact elements 21'", which carry input/output signals.

In the example of figure 4A, which is provided for indicative purposes only and does not limit the scope of present invention, the first conductive portion 30' is arranged on a superficial portion of the

intermediate guide 41, in particular on a face FD thereof, said face FD being a lower face according to local reference system of figure 4A. The first conductive portion 30' may also be arranged on a face FC, opposite to the face FD, of the intermediate guide 41, said face FC being an upper face according to local reference system of figure 4A, or it may be arranged on both faces FC and FD. The conductive portions 30" and 30"' may be formed analogously.

As already observed for the lower guide 40, the conductive portions 30', 30" and 30"' only cover a superficial portion of the intermediate guide 41 as well, in particular only a portion of its face FC and/or its face FD, namely the conductive portions 30', 30" and 30"' do not extend over the entire area of the face FC and/or FD and therefore do not extend over the entire area of the intermediate guide 41.

Furthermore, in the example of figure 4A, the testing head 20 is manufactured according to the so-called "shifted plate technology", wherein the contact elements 21', 21" and 21"', are "buckling beam" contact probes and are initially formed straight, the relative shift of the guides causing a deformation of the probe body, as well as the desired retention of the probes itself thanks to the friction with the walls of the guide holes into which they slide.

In this case, as previously observed for the lower guide 40, also in the intermediate guide 41 the first conductive portion 30' coats at least one portion 41'W of an inner surface of each guide hole of the first group 41' of the guide holes 41h, the second conductive portion 30" coats at least one portion 41"W of an inner surface of each guide hole of the second group 41" of the guide holes 41h, and the third conductive portion 30"' coats at least one portion 41"'W of an inner surface of each guide hole of the third group 41"' of guide holes 41h, the electrical connection between the contact probes 21', 21" and 21"' and the conductive portions 30', 30" and 30"' being established by means of a brushing contact between the body 21pr of the contact probes and the metallized portions 41'W, 41"W and 41"'W, respectively.

It is possible to provide a configuration wherein only one between the lower guide 40 and the intermediate guide 41 comprises the first conductive portion 30' and/or the second conductive portion 30", or it is also possible to provide a configuration wherein both the lower guide 40 and the intermediate guide 41 comprise the first conductive portion 30' and/or the second conductive portion 30".

Figure 4A shows as an example an embodiment wherein both the lower guide 40 and the intermediate guide 41 comprise both the first conductive portion 30' and the second conductive portion 30". This embodiment also increases the possibility of a brushing contact between the contact probes and the conductive portions 30' and 30" and possibly the metallized portions 41'W and 41"W.

Still referring to figure 4A, it is possible to provide a configuration wherein both the intermediate guide 41 and the lower guide 40 comprise the third conductive portion 30'". Alternatively, it is possible to provide a configuration wherein only one between the intermediate guide 41 and the lower guide 40 comprises the third conductive portion 30'" which short-circuits input/output signal contact elements, preferably the lower guide 40.

In a preferred embodiment, schematically shown in figure 4B, the first conductive portion 30' is formed on one between the lower guide 40 and the intermediate guide 41, in particular the lower guide 40, and the second conductive portion 30" is formed on the other between the lower guide 40 and the intermediate guide 41, in particular the intermediate guide 41, in the illustrated example on two faces thereof facing each other, in particular the upper face FA of the lower guide 40 and the lower face FD of the intermediate guide 41, according to the local reference system of figure 4B. Obviously, in this embodiment as well one between the two guides 40 and 41, preferably the lower guide 40, may comprise the third conductive portion 30'". This embodiment simplifies the formation of the conductive portions 30', 30", 30" on different guides.

Obviously, for both the embodiment of figure 4A and the embodiment of figure 4B, it is possible to provide that also the upper guide 42 comprises the first conductive portion 30' and/or the second conductive portion 30" and/or the third conductive portion 30"', as well as it is also possible to provide a configuration wherein the intermediate guide 41 is not present but only the upper guide 42, on which the first conductive portion 30' and/or the second conductive portion 30" and/or the third conductive portion 30"' can be formed, is present.

In a particularly preferred embodiment of the present invention, shown in figures 5A and 5B, a same guide, in particular the lower guide 40 in the example of the figures, comprises the first conductive portion 30', which is formed on the face FA, and comprises the second conductive portion 30", which is formed on the opposite face FB. Analogous considerations can be made for the intermediate guide 41 and the faces FC and FD on which the first and/or second conductive portions 30' and 30" can be formed, and also for the upper guide 42.

It is observed that this embodiment, wherein the first conductive portion 30' and the second conductive portion 30" are formed on two opposite faces of the same guide, is particularly advantageous, since, as schematically shown in figure 5B, in many cases the first contact elements 21' (adapted to carry ground signals) and the second contact elements 21" (adapted to carry power signals) are very close to each other in the testing head 20, for example alternated one after the other, and for this reason it is complicated to form both conductive portions 30' and 30" on a same face of a guide of the testing head 20. In other words, in this embodiment, one of the first and second conductive portions 30' or 30" is adapted to electrically connect the first contact elements 21' (apt to carry ground signals), whereas the other conductive portion, formed on an opposite face of the same guide, is adapted to electrically connect the second contact elements 21" (apt to carry power signals), in particular alternated with the first contact elements 21', in this way simplifying the production of the testing head 20 and avoiding

complicated interlacement of conductive portions. If the first contact elements 21' adapted to carry ground signals and the second contact elements 21" adapted to carry power signals are alternated one after the other, both the conductive portions 30' and 30" are locally interrupted by suitable non-conductive zones 31' and 31" (similarly to what observed in relation to figures 3A-3D), respectively, so as to avoid an electrical connection between ground contact elements and power contact elements. The non-conductive zones 31' and 31" therefore locally prevent an electrical connection between adjacent contact elements apt to carry different signals.

Obviously, even if not shown in figures 5A and 5B, in this embodiment it is also possible to provide the presence, on one of the two faces of the guide, or even on both faces, of the third conductive portion 30"', the latter also possibly interrupted by suitable non-conductive zones if the third contact elements 21"' are very close, for example alternated, to the first contact elements 21' and/or the second contact elements 21".

According to a further alternative embodiment of the present invention illustrated in figure 6, one or more of the conductive portions 30', 30" and 30"' (the second conductive portion 30" in figure 6) comprises a plurality of conductive portions that are overlapped and electrically insulated from each other, said conductive portions being identified with the reference number 30"1-30"n in figure 6. In this case, a first layer 30"1 is formed on the face FA of guide 40, and the subsequent layers are formed starting from the first layer 30"1, consecutive conductive layers being separated from each other by a non-conductive layer 38". In this way, different conductive layers may form common conductive plans for different power (or ground or signal) domains, if needed by a particular application.

As an example, if the testing head 20 has to carry a plurality of different power signals (indicated in figure 6 as Vcc1 and Vcc2), in this embodiment the face FA of the guide 40 comprises a corresponding number of layers 30"1-30"n of the second conductive portion 30", each

layer being adapted to electrically connect the respective second contact elements 21" adapted to carry a single specific power signal. Furthermore, the other face of the guide, in the example the face FB, can be covered by the first conductive portion 30', which electrically connects the contact elements 21' adapted to carry ground signals. In this case too, each conductive layer may be locally interrupted by suitable non-conductive zones 31" in order to not electrically connect contact elements that must not be short-circuited to each other. In particular, the non-conductive zones 31" of a layer are formed at the holes housing contact elements that must not be short-circuited by said layer, whereas said layer covers at least partially the walls of the guide holes housing contact elements that must be short-circuited by it.

The conductive portions 30', 30" and 30"' may therefore be more than one, as there can be more than one power, ground and signal domains (the latter occurs when different groups of pads of the device under test need to be short-circuited), and possibly may be arranged on different levels if required.

As observed before, in figures 2A-2C, 4A-4B, 5A-5B and 6, the contact elements 21', 21" and 21"' are contact probes of the "buckling beam" type.

In a further alternative embodiment of the present invention, shown in figure 7, the contact elements of testing head 20 are in the form of pogo pins. In this embodiment, the testing head 20 comprises the lower guide 40 and the upper guide 42 and does not comprise the intermediate guide 41.

In particular, each contact element 21', 21" and 21"' comprises a body 21pp that includes a casing 33 and an elastic member 34 arranged inside the casing 33. A first end of the elastic member 34 is connected to a first end portion or contact tip 24 of the pogo pin, whereas a second end of the elastic element 34, opposite the first end, is connected to a second end portion or contact head 25 of the pogo pin. The contact tip

24, which is inserted into guide holes 40h formed in the lower guide 40, is adapted to abut onto contact pads 26 of a device under test integrated on a wafer 27, whereas the contact head 25, which is inserted into guide holes 42h formed in the upper guide 42, is adapted to abut onto contact pads 28 of a space transformer 29, the lower guide 40 and the upper guide 42 being separated by a gap 35.

The casing 33 of each pogo pin preferably has a cylindrical shape, but obviously other shapes are also possible.

Conveniently, the lower guide 40 and/or the upper guide 42 comprises the first conductive portion 30', which includes and electrically connects the holes of a first group 40' of the guide holes 40h to each other, and/or the holes of a first group 42' of guide holes 42h. Obviously, the lower guide 40 and/or the upper guide 42 may also comprise the second conductive portion 30", which includes and electrically connects the holes of a second group 40" of the guide holes 40h to each other, and/or the holes a second group 42" of guide holes 42h. The lower guide 40 and/or the upper guide 42 may also comprise the third conductive portion 30"', which includes and electrically connects the holes of a third group 40"' of guide holes 40h to each other, and/or the holes of a third group 42"' of the guide holes 42h, the third conductive portion 30"' being preferably formed on the lower guide 40.

The guide holes of the first group 40' and/or of the first group 42' house first contact elements or pogo pins 21' adapted to carry ground signals, the guide holes of the second group 40" and/or of the second group 42" house second contact elements or pogo pins 21" adapted to carry power signals, whereas the guide holes of the third group 40"' and/or the third group 42"' house third contact elements or pogo pin 21"' adapted to carry input/output signals between the device under test and the test equipment.

The casing 33 of the body 21pp of each pogo pin is shaped so as to

define a first surface S1 and a second surface S2, arranged at opposite ends of the casing 33 along a longitudinal axis H-H thereof, which surfaces S1 and S2 are adapted to abut onto the lower guide 40 and the upper guide 42, respectively, the casing 33 of the pogo pins having a maximum cross-sectional size (generally around 80 μm) that is greater than a diameter of the guide holes, the term diameter indicating a maximum cross-sectional size of the guide holes, even of non-circular section.

The contact tip 24 and the contact head 25 are electrically connected to the casing 33 of the pogo pins, said casing 33 being made of a conductive material.

In this way, the pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the first conductive portion 30' ensures the electrical connection between the first pogo pins 21' housed in the first group 40' and 42' of guide holes of the lower guide 40 and the upper guide 42, respectively, said pogo pins being adapted to carry ground signals, while the pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the second conductive portion 30" ensures the electrical connection between the second pogo pins 21" housed in the second group 40" and 42" of guide holes of the lower and upper guide 40 and 42, respectively, said pogo pins being adapted to carry power signals. Similarly, the pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the third conductive portion 30'" ensures the electrical connection between the third pogo pins 21'" housed in the third group 40'" and 42'" of guide holes of the lower and upper guides 40 and 42, respectively, said pogo pins being adapted to carry input/output operating signals.

In other words, the electrical connection between the pogo pins 21', 21" and 21'" and the conductive portions 30', 30" and 30'", respectively, is in this case performed by means of a pressing contact of the first surface S1 and the second surface S2 of the casing 33 on the lower

guide 40 and on the upper guide 42, respectively, the conductive portions being formed on a superficial portion of the lower guide 40, in particular on a face FA thereof, said face FA being an upper face according to the local reference system of figure 7, and/or on a face FE of the upper guide 42, said face FE being a lower face, still according to local reference system of figure 7.

The use of pogo pins as contact elements is particularly advantageous because in this case it is not necessary to guarantee a brushing contact between the contact elements and the inner surface of the guide holes, a pressing contact between the casing 33, in particular between the surfaces S1 and S2 thereof, and the guides being sufficient to ensure the proper electrical connection between the conductive portions and the contact elements, wherein suitable groups of those contact elements are in this way electrically connected (short-circuited) to each other.

According to a further embodiment of the present invention, shown in figure 8A, the lower guide 40, which comprises the first conductive portion 30', comprises at least one first common pad 36' connected to the first conductive portion 30' by means of a first conductive track 37'. In this way, the first contact elements 21' adapted to carry ground signals are connected to the first common pad 36' by means of the first conductive track 37', the first common pad 36' therefore being a common ground pad. Even if figure 8A only shows the lower guide 40, also the intermediate guide 41 and/or the upper guide 42 may comprise a first common pad and a respective first conductive track.

The common pad 36' may be connected by means of a first connection wire to a housing (not shown) of the testing head 20.

Furthermore, as shown in figure 8B, the lower guide 40 and/or the intermediate guide 41 and/or the upper guide 42 (the lower guide 40 in the figure) may comprise at least one second common pad 36" connected to the second conductive portion 30" by means of a second conductive track 37". In this way, the second contact elements 21"

adapted to carry power signals are connected to the second common pad 36" by means of the second conductive track 37", the second common pad 36" therefore being a common power pad.

As shown in figure 8C, the lower guide 40 and/or the intermediate guide 41 and/or the upper guide 42 (the lower guide 40 in the figure) may also comprise at least one third common pad 36'" connected to the third conductive portion 30'" by means of a third conductive track 37'". In this way, the third contact elements 21'" adapted to carry input/output operating signals are connected to the third common pad 36'" by means of the third conductive track 37'", the third common pad 36'" therefore being a common signal pad.

The presence of a common pad 36', 36", 36'" connected to the respective conductive portion 30', 30", 30'" allows to extract a respective signal from the testing head 20 and to connect it, for example, to a PCB connected to the testing head 20. The common pad therefore can carry a monitoring signal, for example of the voltage levels on the corresponding guide.

As shown in figure 9A, it is also possible to provide the presence on a guide of a further conductive portion 30bis added to the conductive portions 30', 30" and 30'", the further conductive portion 30bis including and metallizing a single guide hole 40h, preferably housing a third contact element 21'" which carries input/output signals. In this case, the guide also comprises a further common pad 36bis connected to the further conductive portion 30bis by means of a further conductive track 37bis. In this way, the third contact element 21'" housed in such a metallized hole is electrically connected to the further common pad 36bis by means of the further conductive track 37bis, so that it is possible for example to transport an input/output signal from the further common pad 36bis towards a PCB. It is also possible to provide the presence of a plurality of further conductive portions, separated from each other, each performing the metallization of a respective single guide hole 40h, such further conductive portions being

possibly connected to each other by means of conductive tracks or by means of circuit components if needed.

Furthermore, according to an alternative embodiment of the present invention shown in figure 9B, it is possible to provide that at least two conductive portions (two first conductive portions 30' in figure 9B, but not limited to these) of the guide 40 are electrically connected to each other by means of a conductive track 39 in the guide, so as to be able to electrically connect to each other groups of contact elements adapted to carry a same type of signal but that are housed in respective groups of guide holes distanced from each other in the guide (two groups 40' in figure 9B but not limited to these).

Finally, according to an embodiment shown in figures 10A and 10B, the guide 40, which comprises at least one conductive portion (the conductive portion 30' in the figures but not limited thereto), also comprises at least one circuit component 50 connected to the conductive portion, which forms a common conductive plane.

In particular, in the example of figure 10A, the guide 40 comprises at least two conductive portions (two first conductive portions 30' in the figure but not limited thereto), the circuit component 50 being electrically connected thereto. As an example, the circuit component 50 is a filtering capacitor, still indicated with the reference number 50, having its rheophores 50r connected to respective conductive portions. The capacitor 50 is able to electrically connect to each other conductive portions that are apt to short-circuit contact elements adapted to carry ground, power, or input/output signals. Advantageously, such an embodiment allows to maximize the filtering effect of the capacitors 50, and therefore to reduce the interferences caused by contact elements that carry ground and power signals to a minimum, as well as to optimize the loop-back technique, since said capacitors 50 are thus positioned as close as possible to the contact tips of the contact elements (i.e. on the lower guide 40), namely close to the wafer 27.

Alternatively, as shown in figure 10B, it is also possible to provide a configuration wherein the capacitor 50 has a first rheophore 50r1 connected to a conductive portion which includes a plurality of guide holes (the conductive portion 30' in the figure but not limited to this) and the other rheophore 50r2 connected to a conductive portion that includes and metallizes a single guide hole.

The circuit component 50, which is preferably a filtering capacitor, may also be any other component suited for specific needs, as for example an inductor or a resistor or a relay, possibly housed in suitable housing seats formed in the guide. For example, it is possible connect a pair of inductors at two conductive portions (such as the two first conductive portions 30' in the figure but not limited to these) apt to be short-circuited in a loop-back configuration and to monitor the signal at those conductive portions.

In conclusion, the present invention provides a testing head wherein at least one guide comprises at least one conductive portion that includes and electrically connects to each other guide holes adapted to house contact elements carrying a same type of signal.

Advantageously according to the present invention, the contact elements that carry ground signals are therefore electrically connected in the testing head, preferably at the lower guide, which allows to considerably reduce (or even to completely eliminate) the signal noise generated by the different grounds, since the conductive portion of the guide forms a ground plane common to all the ground contact elements.

Similarly, also the electrical connection between the contact elements that carry power signals contributes to reducing interferences and therefore the noise in the testing head. In this way, advantageously according to the present invention, it is possible to reduce the common mode noise.

Consequently, the present invention allows an overall improvement of

the frequency performances of the testing head.

Furthermore, also the electrical connection between contact elements that carry operating signals (i.e. input/output signals), preferably at the lower guide, allows an increase of the frequency performances of the testing head in case there is a need to electrically connect two or more contact pads of the device under test.

Advantageously, it is possible to short-circuit groups of probes to each other (and therefore also the corresponding pads of the device), without transporting the relative signal of the test equipment, said short-circuit occurring at the lower and/or intermediate guide, i.e. close to the device under test, in this way improving the electrical performances of the short-circuit.

The possibility of short-circuiting the ground and power contact elements allows to improve also the current performances of the testing head of the present invention, also avoiding possible burning of the contact elements.

It is also possible to obtain a testing head with improved performances in terms of signal filtering, thanks to the presence of suitable circuit components, in particular capacitors electrically connected to the conductive portions.

Finally, the presence of a common pad allows to access to the contact elements directly from the housing of the testing head, such a common pad therefore replacing the plurality of contact pads and also allowing monitoring of the respective signals.

Obviously, a person skilled in the art, in order to meet particular needs and specifications, can carry out several changes and modifications to the testing head described above, all included in the protection scope of the invention as defined by the following claims.

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CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h) adapted to house a plurality of contact elements (21', 21", 21'"), each of said contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), said testing head (20) being characterized in that said at least one guide (40, 41, 42) comprises at least one conductive portion (30', 30", 30'") that includes and electrically connects the holes of at least one group (40', 40"; 40'"; 41'; 41", 41'"; 42', 42", 42'") of said guide holes (40h, 41h, 42h) to each other and is apt to contact a corresponding group of said contact elements (21', 21", 21'"), said contact elements (21', 21", 21'") of said corresponding group being adapted to carry a same type of signal.

2. The testing head (20) according to claim 1, characterized in that it comprises at least one first conductive portion (30') and at least one second conductive portion (30"), said first conductive portion (30') including and electrically connecting the holes of a first group (40', 41', 42') of said guide holes (40h, 41h, 42h) to each other, said first group (40', 41', 42') housing first contact elements (21'), said second conductive portion (30") including and electrically connecting the holes of a second group (40", 41", 42") of said guide holes (40h, 41h, 42h) to each other, said second group (40", 41", 42") housing second contact elements (21").

3. The testing head (20) according to claim 2, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

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4. The testing head (20) according to claim 2 or 3, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41, 42), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41, 42).

5. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

6. The testing head (20) according to claim 5, characterized in that said at least one guide (40, 41, 42) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

7. The testing head (20) according to claim 2, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

8. The testing head (20) according to claim 2, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said

intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"), said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

9. The testing head (20) according to claim 7 or 8, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

10. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30'") that includes and electrically connects the holes of a third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, said third group (40'", 41'", 42'") housing third contact elements (21'").

11. The testing head (20) according to claim 10, characterized in that said third contact elements (21'") housed in said third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) are adapted to carry input/output signals between the device under test and a test equipment.

12. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") covers at least one portion (40'W, 40"W , 40'"W; 41'W, 41"W, 41'"W) of an inner surface of each guide hole of said group (40', 40", 40'"; 41', 41", 41'") of said guide holes (40h, 41h).

13. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21'") are contact probes wherein said body (21pr) has a deformation.

14. The testing head (20) according to any one of the claims from 1 to 6, characterized in that said contact elements (21', 21", 21'") are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1, S2) being apt to abut onto said at least one guide (40, 42), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said first and/or second surface (S1, S2).

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

16. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42).

17. The testing head (20) according to any one of the claims from 1 to 15, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41, 42), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") are formed.

18. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h, 42h) apt to house a single contact element, said at least one guide (40, 41, 42) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

19. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41, 42).

20. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') comprises a plurality of conductive portions overlapped to and electrically insulated from each other.

21. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h, 42h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21"'), said contact elements included in said respective groups being adapted to carry a same type of signal.

22. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41, 42).

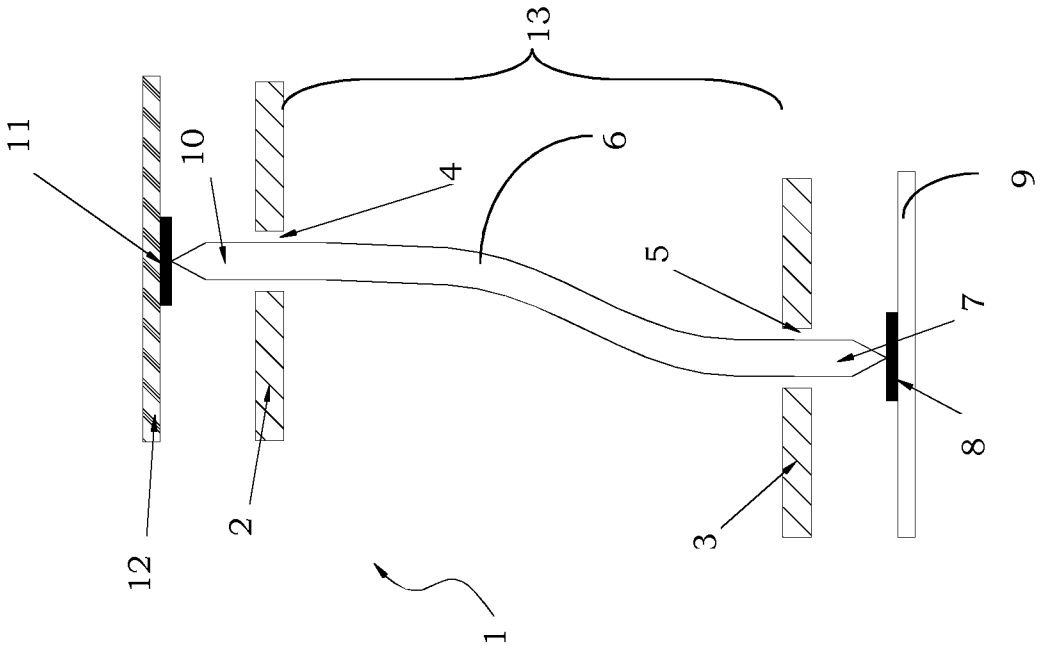


FIG. 1
PRIOR ART

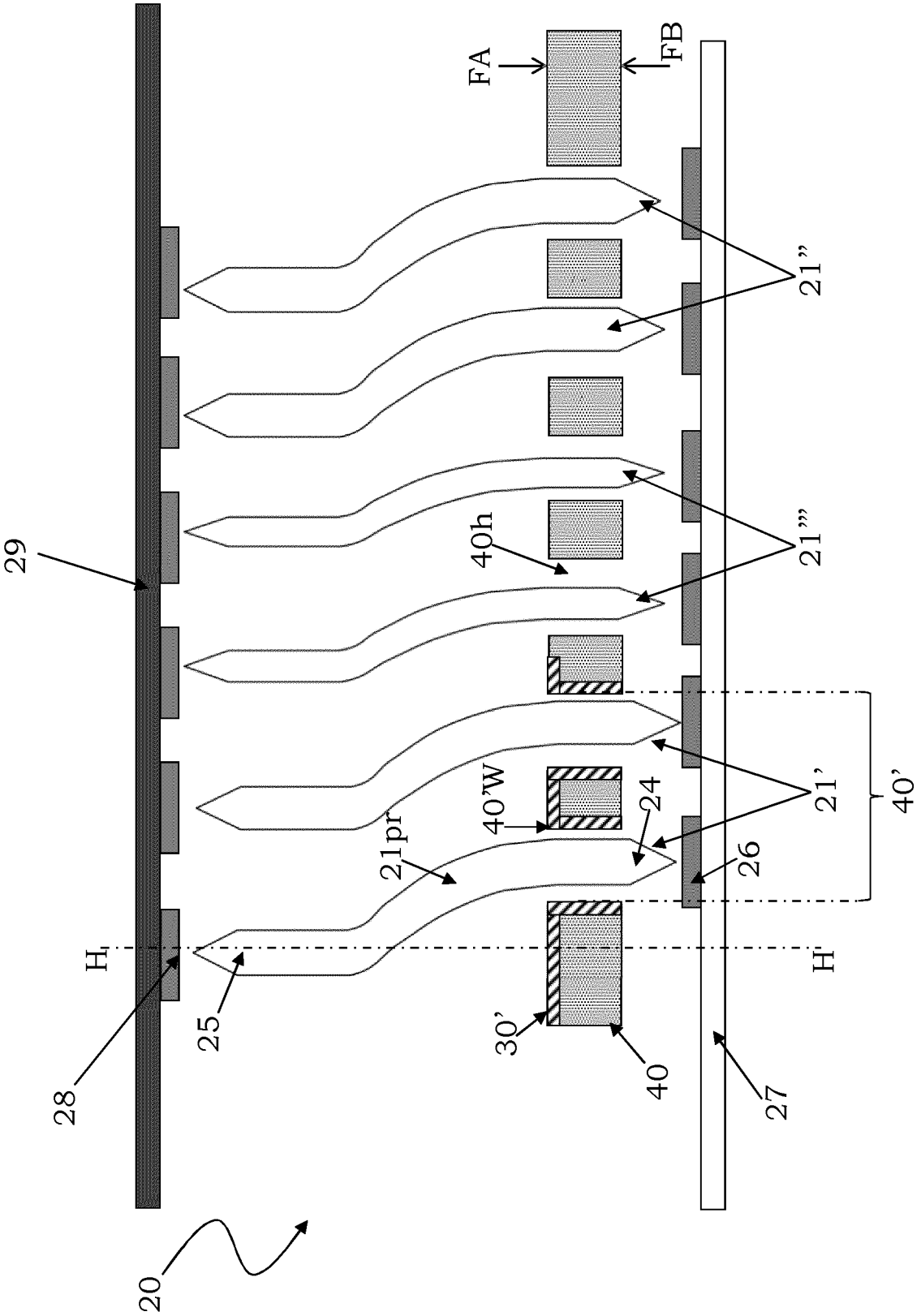


FIG. 2A

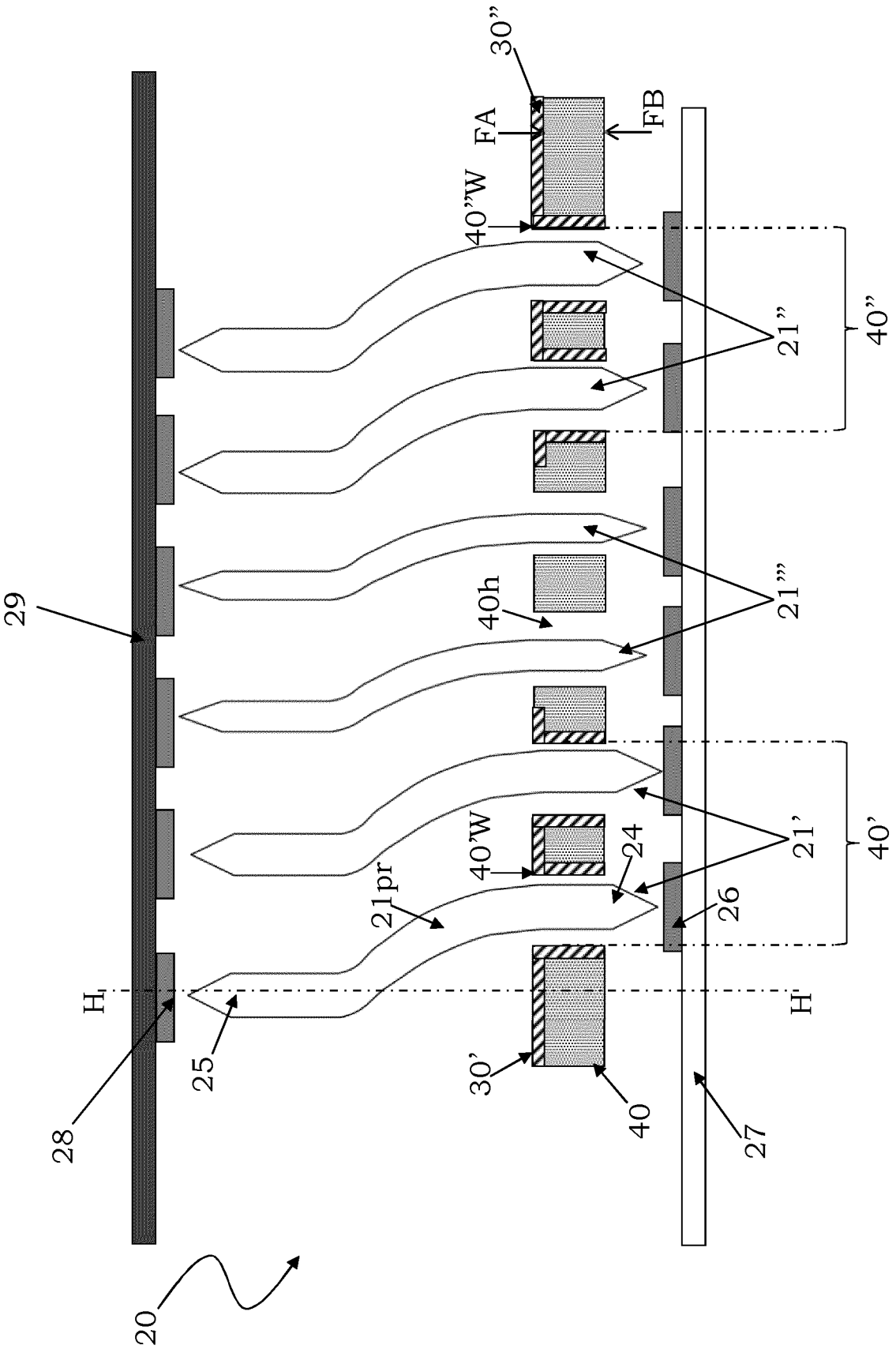


FIG. 2B

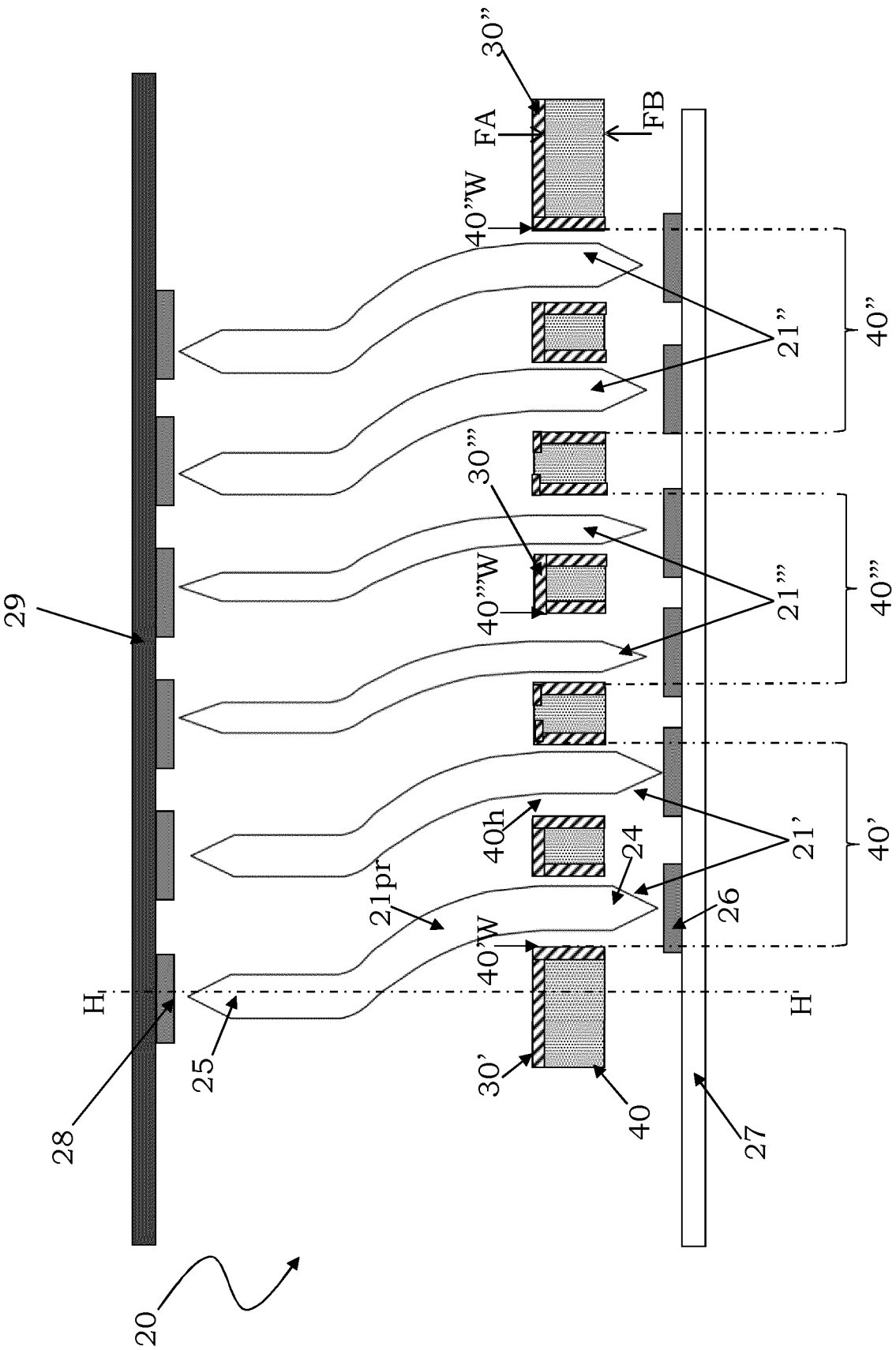

30”
FA
FB
40”W
21”
40”
30”’
40”’W
21”’
40”’
29
40h
24
21’
40’
21pr
26
40’W
H
H
25
30’
40
27
28
20

FIG. 2C

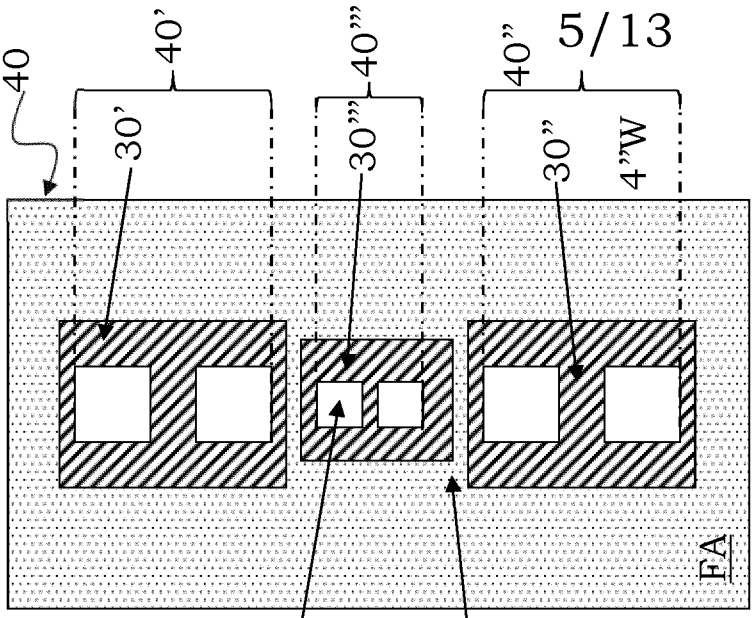


FIG. 3C

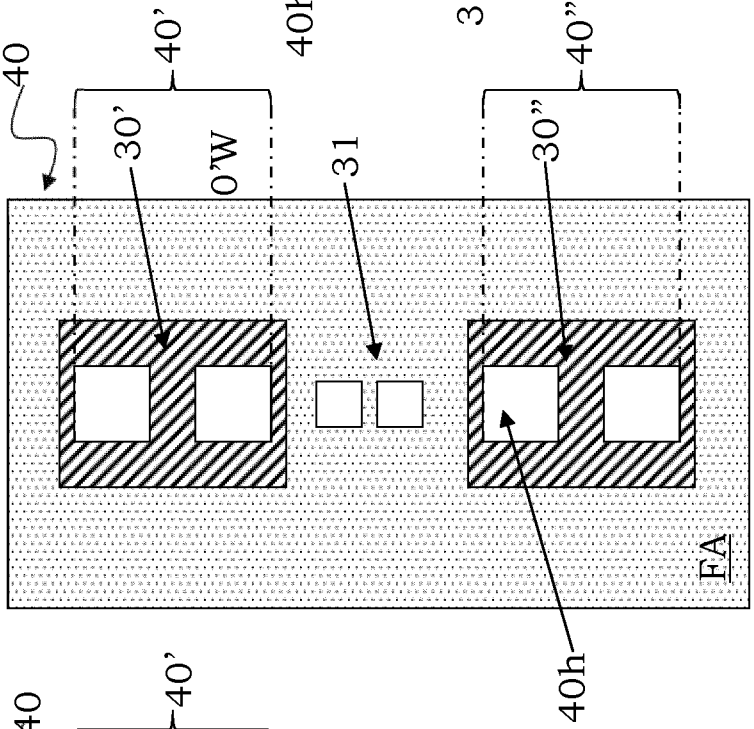


FIG. 3B

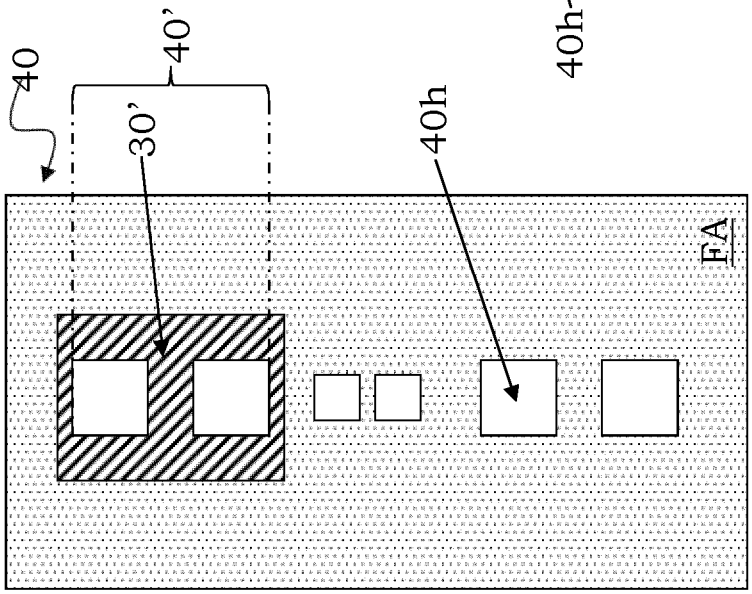


FIG. 3A

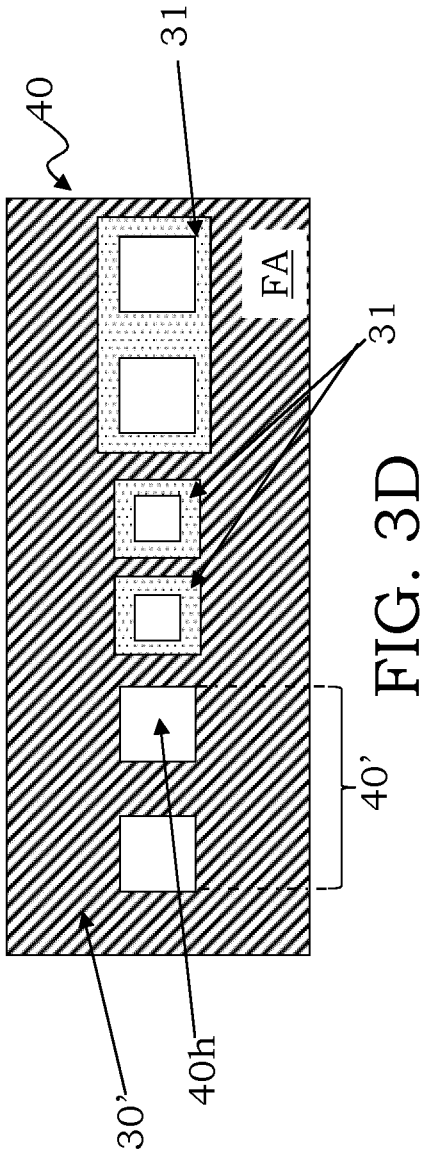


FIG. 3D

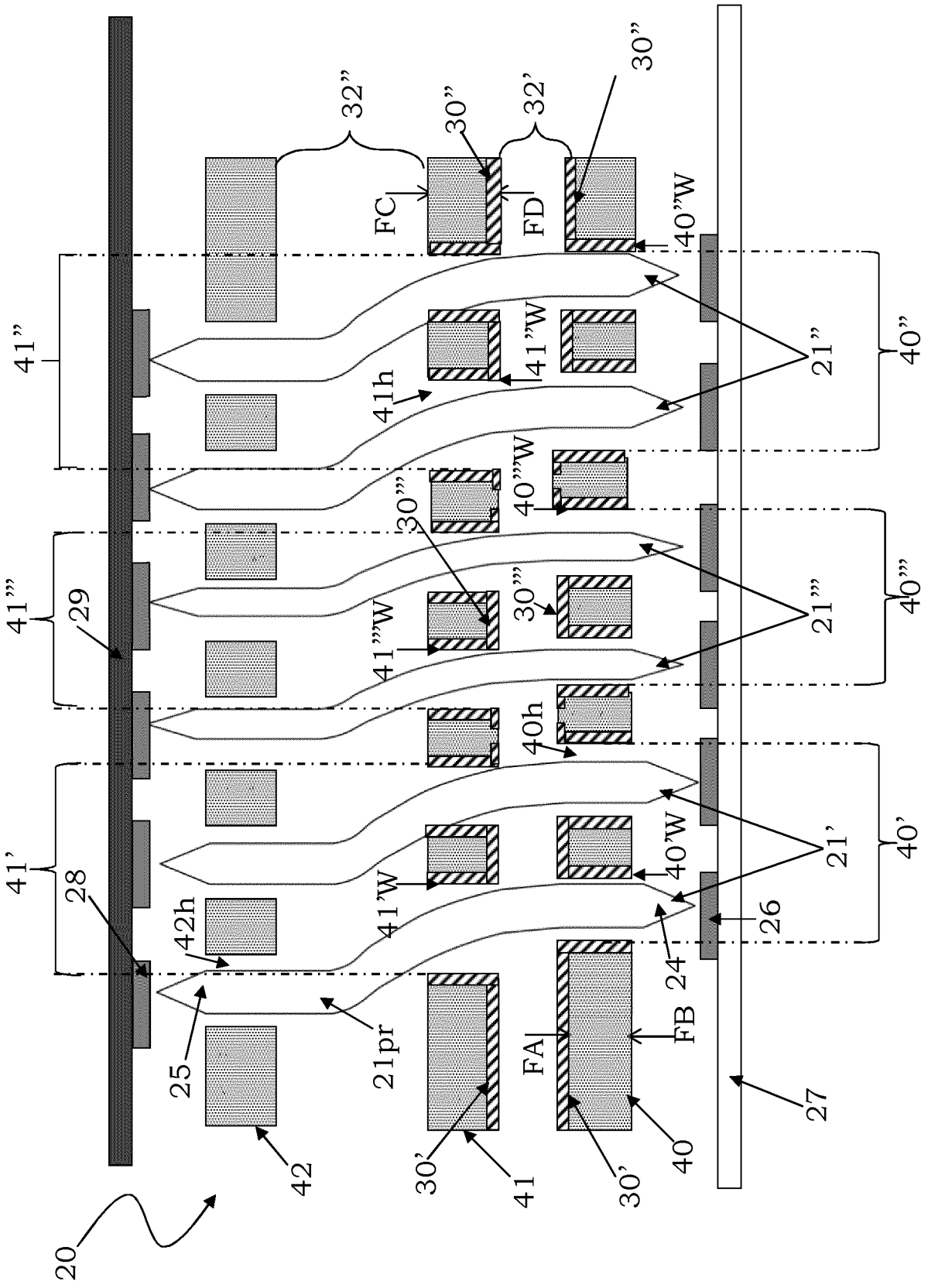

20
42
25
42h
28
41'
29
41''
41'''
30'
41
30'
40
FA
FB
FC
FD
32''
30''
32'
30''
40''W
41''W
41h
40'''W
30'''
41'''W
40h
40'W
41'W
21pr
24
26
27
21''
40''
21'''
40'''
21'
40'

FIG. 4A

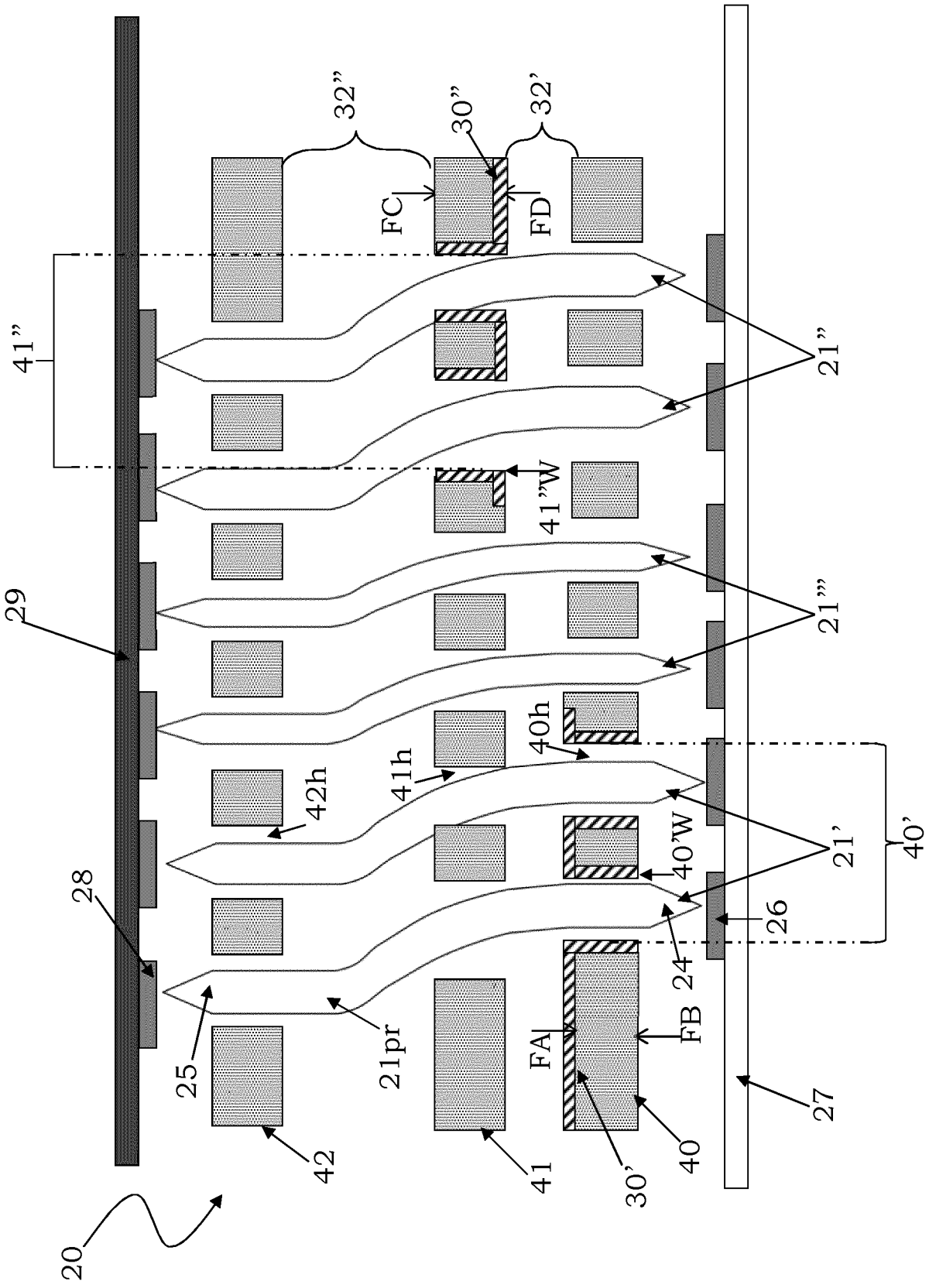

32”
30”
32’
FC
FD
41”
21”
41”W
29
21”’
40h
41h
42h
40’W
21’
40’
28
26
24
25
21pr
FA
FB
27
42
41
30’
40
20

FIG. 4B

FIG. 5A

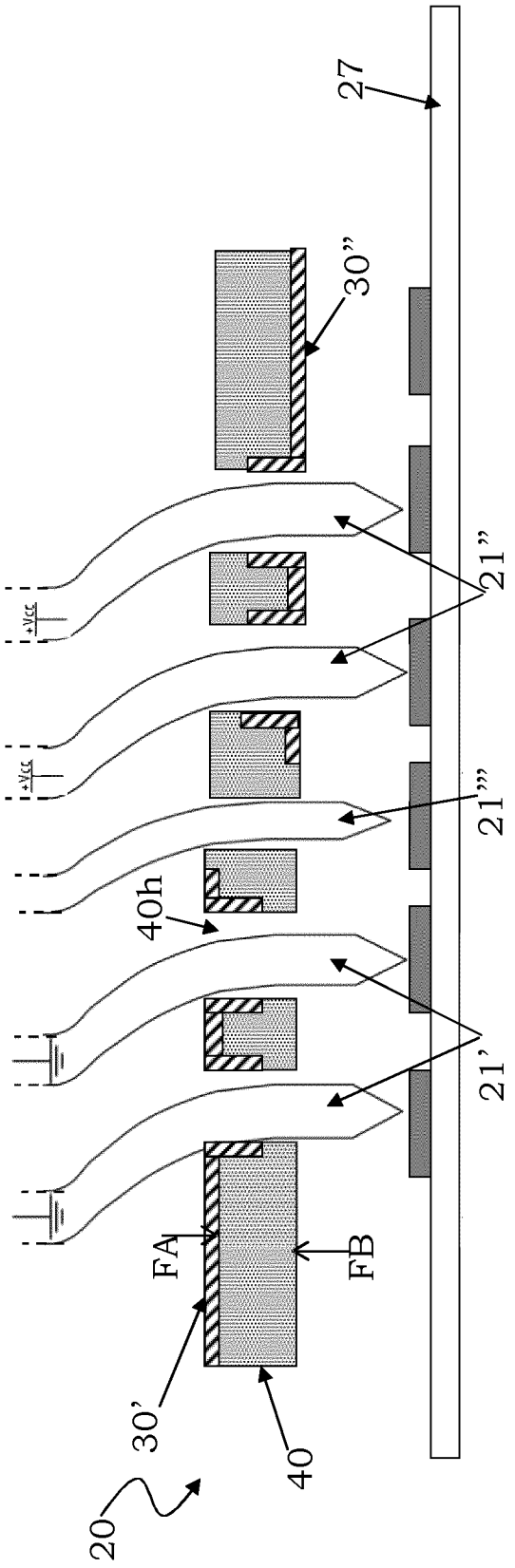
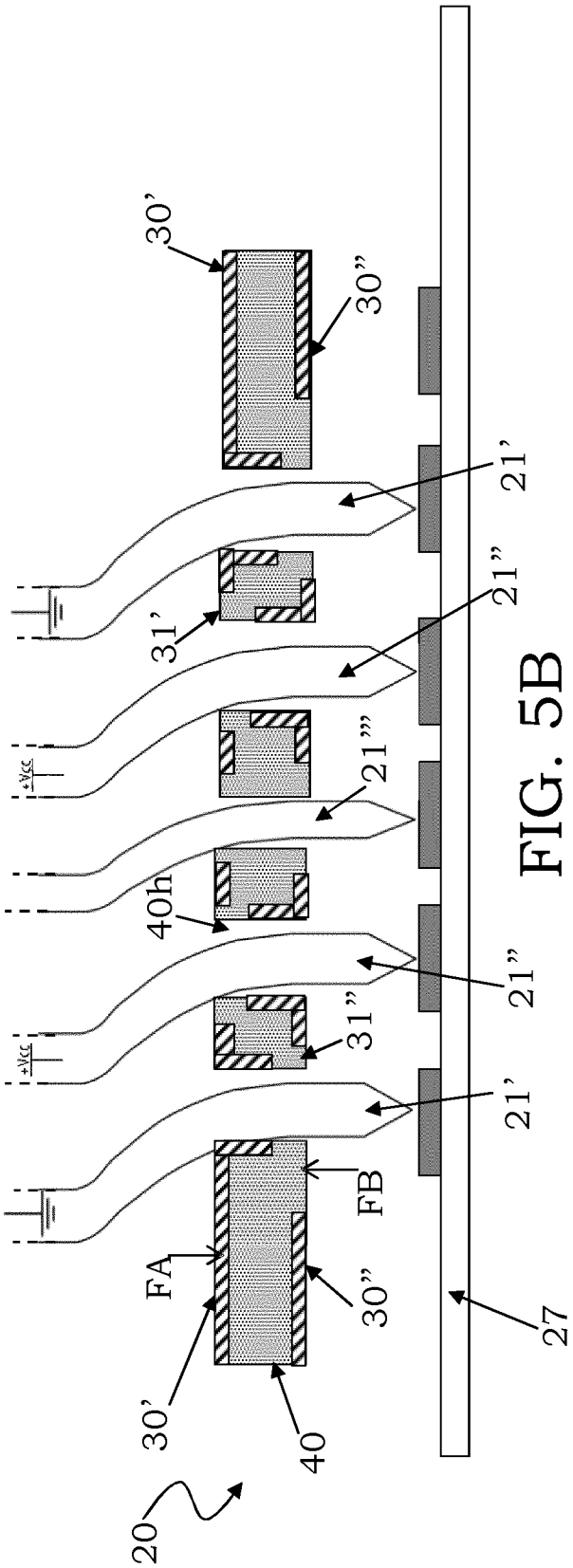

27
30”
21”
21’”
40h
21’
FA
FB
30’
40
20

FIG. 5B


30’
30”
21’
31’
21”
21’”
40h
31”
21”
21’
FB
FA
30”
30’
40
27
20

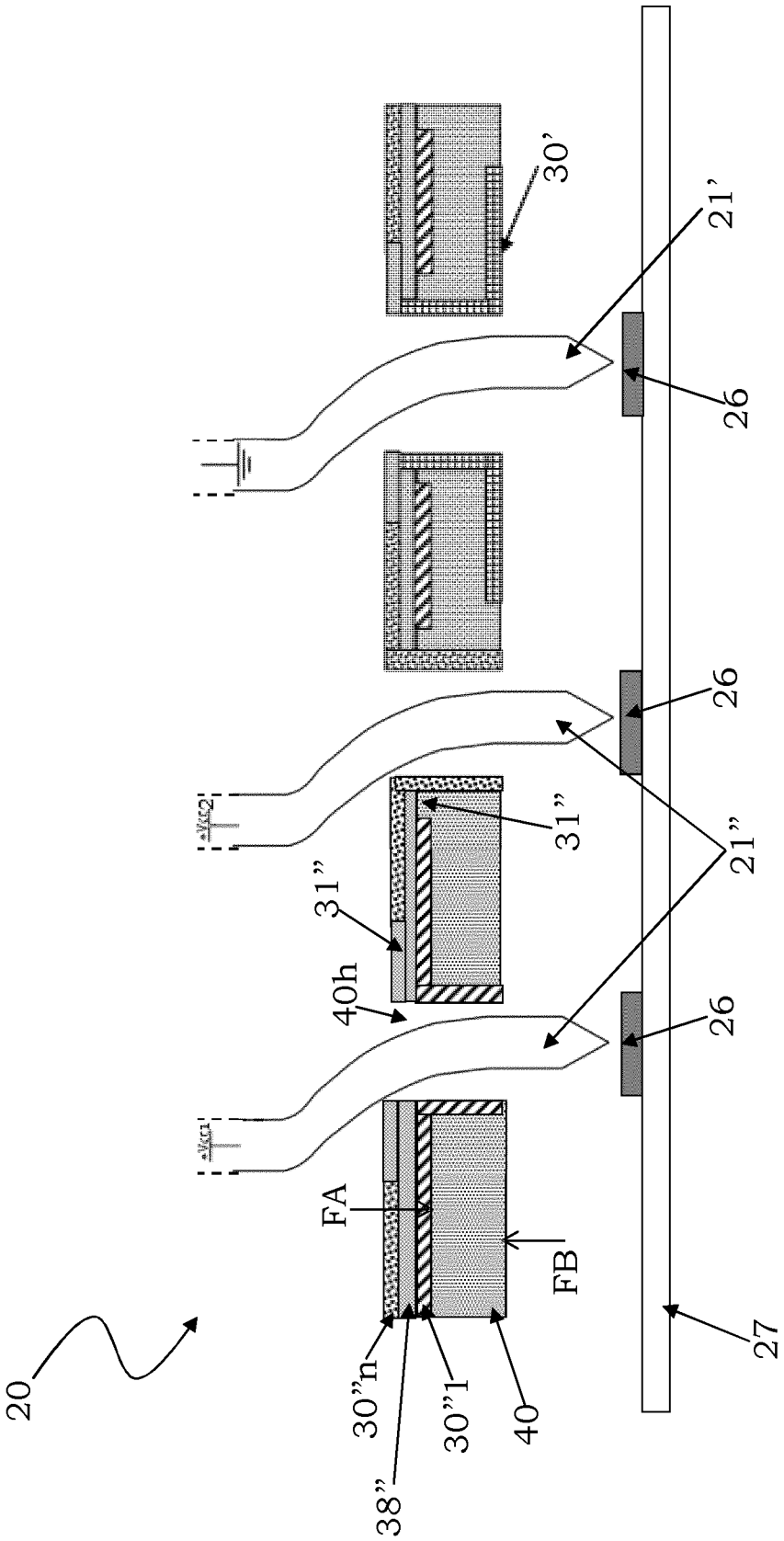


FIG. 6

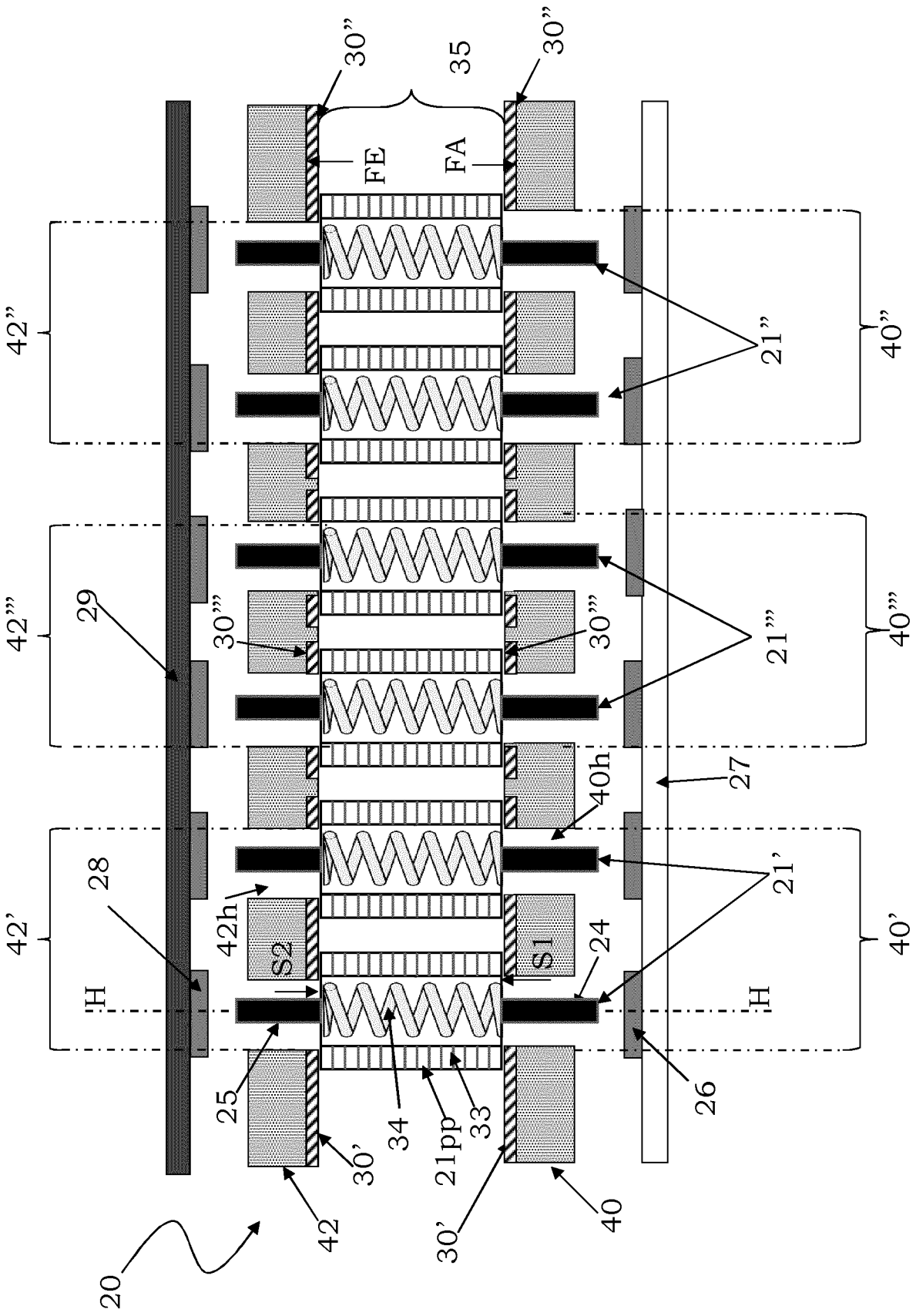

30”
35
30”
FE
FA
42”
21”
40”
42”’
29
30”’
30”’
21”’
40”’
40h
27
42’
28
42h
S2
S1
24
21’
40’
H
H
25
34
21pp
33
26
30’
30’
42
40
20

FIG. 7

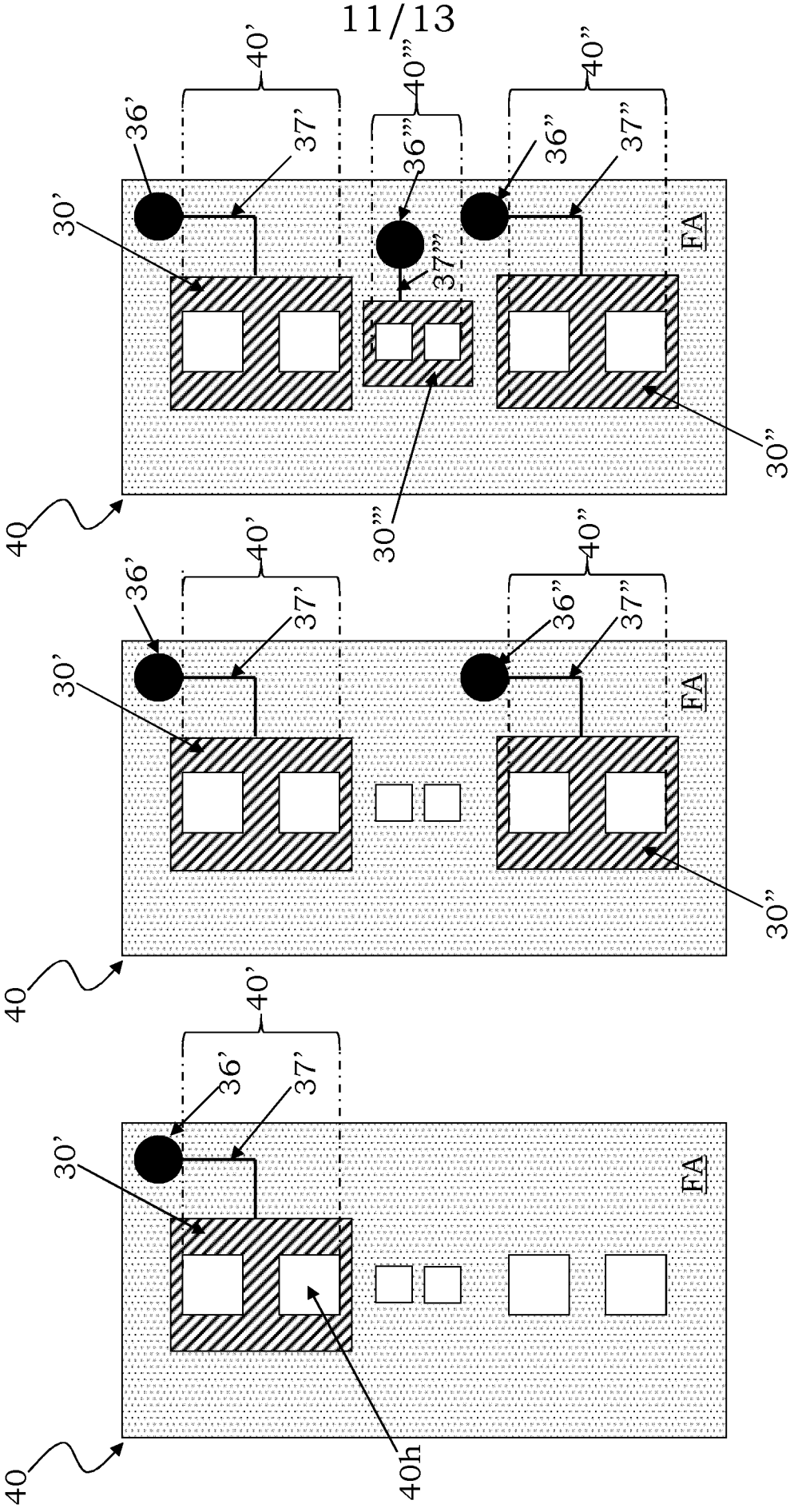


FIG. 8C

FIG. 8B

FIG. 8A

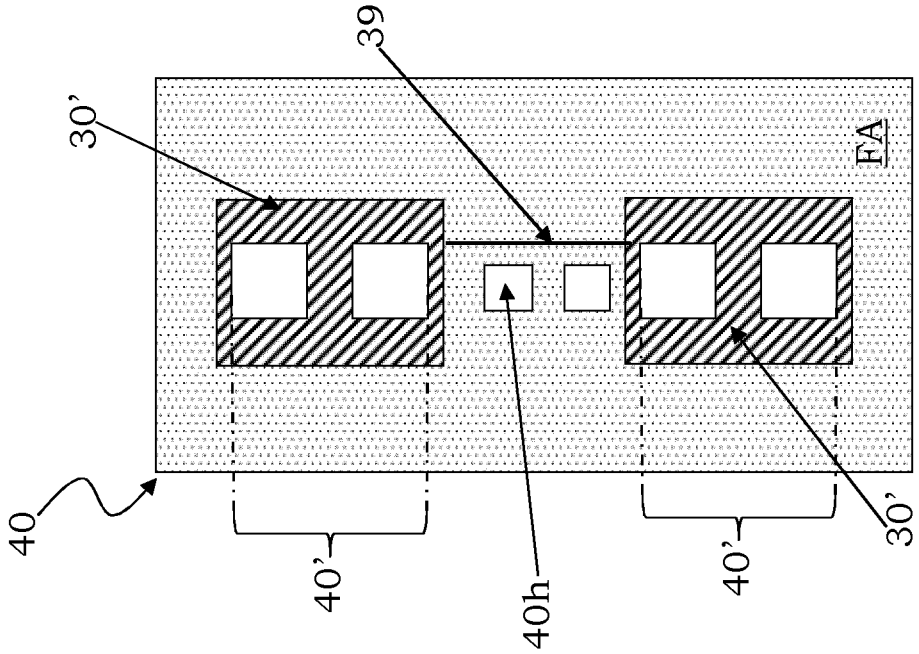

39
30'
FA
40
40'
40h
40'
30'

FIG. 9B

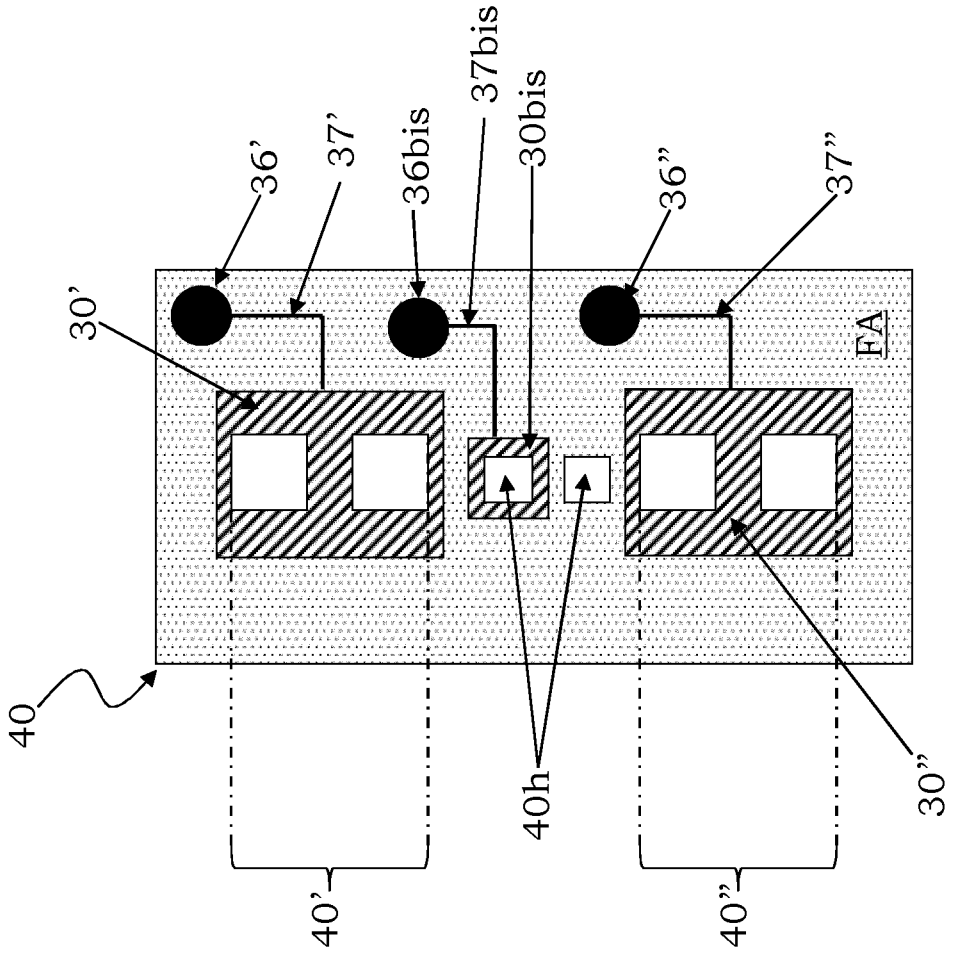

37bis
36'
37'
36bis
30bis
36''
37''
30'
FA
40
40h
30''
40'
40''

FIG. 9A

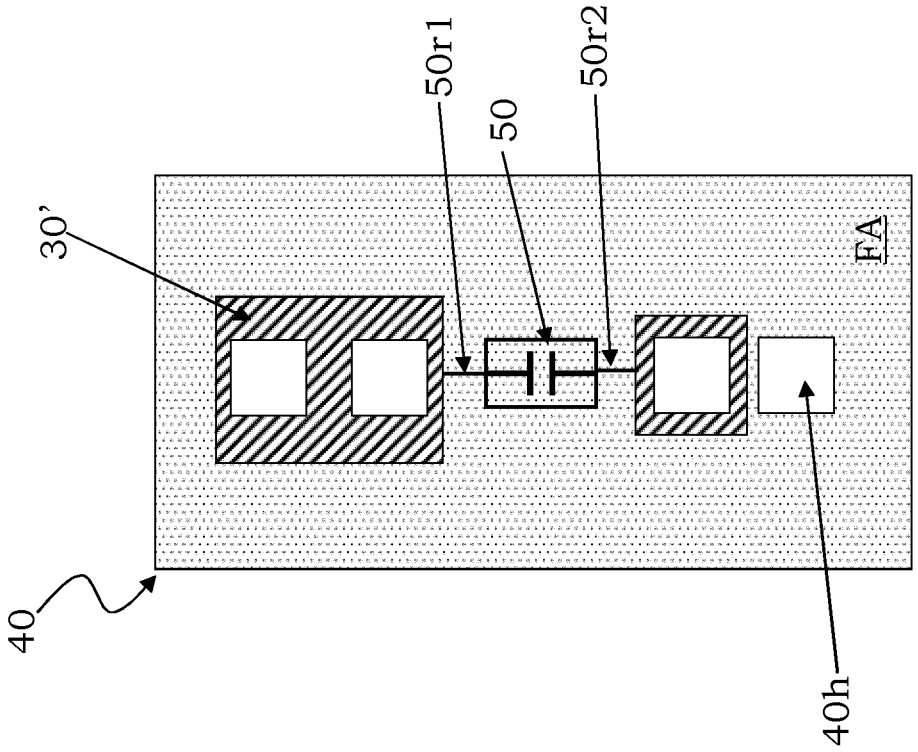


FIG. 10B

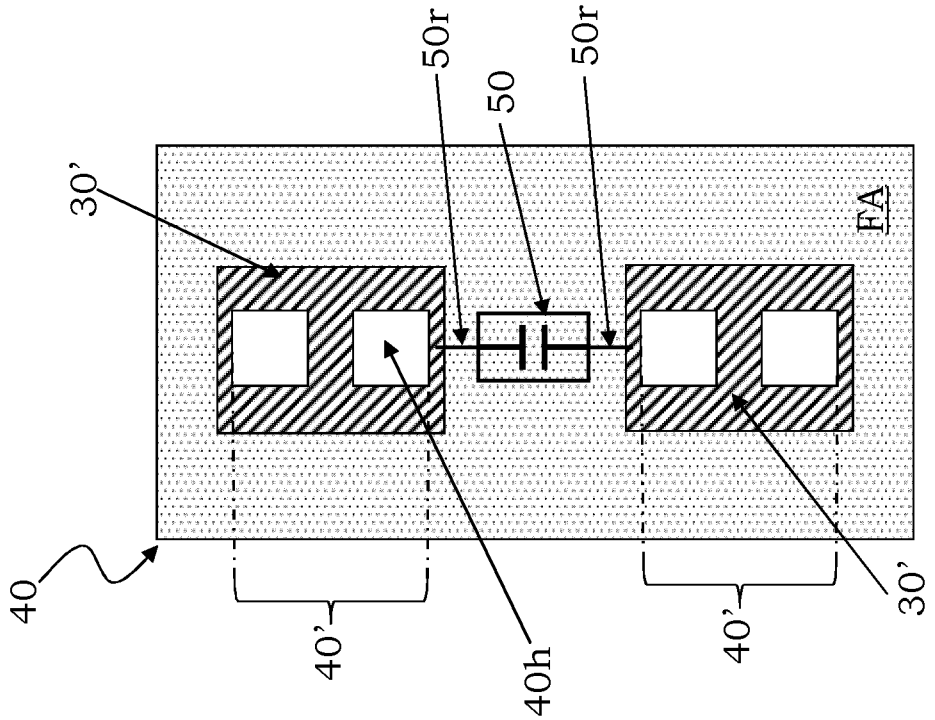


FIG. 10A

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/082180

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01R1/073
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01R

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27) paragraph [0019] - paragraph [0038]; figures 1-6	1-22
X	KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22) the whole document	1-22
X	US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17) paragraph [0024] - paragraph [0037]; figures 2-6	1-22
X	WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09) page 6 - page 17; figures 1-16	1-22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 April 2018	17/04/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Hijazi, Ali

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2017/082180

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012242360 A1	27-09-2012	SG 184681 A1	30-10-2012
		TW 201239365 A	01-10-2012
		US 2012242360 A1	27-09-2012
KR 101421051 B1	22-07-2014	NONE	
US 2014197860 A1	17-07-2014	NONE	
WO 2012106220 A1	09-08-2012	JP 6157047 B2	05-07-2017
		JP 2012159422 A	23-08-2012
		TW 201246727 A	16-11-2012
		WO 2012106220 A1	09-08-2012

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DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

International application number:		**PCT/EP2017/082180**
International filing date:		**11 December 2017 (11.12.2017)**
Document type:		**Certified copy of priority document**
Document details:	Country/Office:	**IT**
	Number:	**102016000127581**
	Filing date:	**16 December 2016 (16.12.2016)**
Date of receipt at the International Bureau:		**08 February 2018 (08.02.2018)**

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-*bis*)

34, chemin des Colombettes
1211 Geneva 20, Switzerland
www.wipo.int

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IPR2024-00933

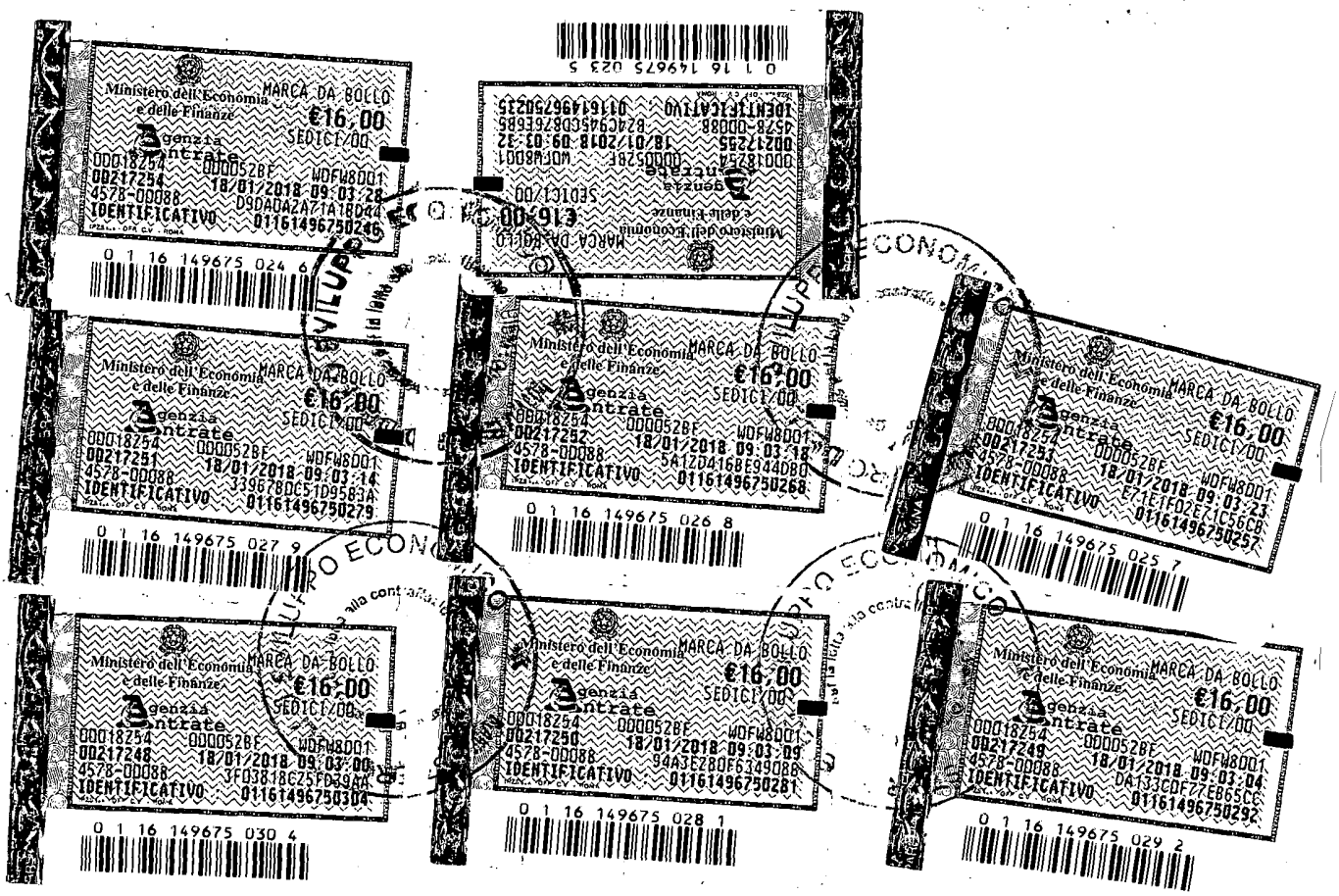
EP17 /82180

Ministero dello Sviluppo Economico

Direzione Generale Per La Lotta Alla Contraffazione - UIBM

Ufficio Italiano Brevetti e Marchi – Divisione V

Autenticazione di copia di documenti relativi alla domanda di brevetto per:
INVENZIONE INDUSTRIALE N. 102016000127581 (UA2016A009128).



Copia della documentazione di origine cartacea e/o riproduzione cartacea della documentazione di origine informatica debitamente firmata e depositata presso questo ufficio.

Si compone di pagg. 42 (compreso il frontespizio).

ROMA li 18 GEN. 2018

IL FUNZIONARIO

Dr.ssa Cristina Papadia

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UIBM

MINISTERO DELLO SVILUPPO ECONOMICO
Direzione Generale per la Lotta alla Contraffazione
Ufficio Italiano Brevetti e Marchi

Attestato di deposito

di

Invenzione industriale

Numero di domanda: 102016000127581

Data di deposito: 16/12/2016

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Ministero dello Sviluppo Economico

Ricevuta di presentazione

per

Brevetto per invenzione industriale

Domanda numero: 102016000127581

Data di presentazione: 16/12/2016

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DATI IDENTIFICATIVI DEL DEPOSITO

Ruolo	Mandatario
Data di compilazione	16/12/2016
Titolo	Testa di misura per un'apparecchiatura di test di dispositivi elettronici con migliorate proprietà di filtraggio
Carattere domanda	Ordinaria
Esenzione	NO
Accessibilità al pubblico	NO
Numero rivendicazioni	27
Autorità depositaria	

RICHIEDENTE/I

Natura giuridica	Persona giuridica
Denominazione	TECHNOPROBE S.p.A.
Partita IVA	02272540135
Nazione sede legale	Italia
Tipo Società	societa' per azioni

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CAP	20124
Comune	Milano
Telefono	02 - 6704275
Fax	02 - 6703250
Indirizzo Email \ PEC	uibm-bef@pec.it

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Riferimento depositante	TEC078BIT

MANDATARI/RAPPRESENTANTI

Cognome	Nome
Botti	Mario
Ferreccio	Rinaldo
Ferrari	Barbara

INVENTORI

Cognome	Nome	Nazione residenza
MAGGIONI	Flavio	Italia

CLASSIFICAZIONI

Sezione	Classe	Sottoclasse	Gruppo	Sottogruppo
G	01	R	31	

NUMERO DOMANDE COLLEGATE

DOCUMENTAZIONE ALLEGATA

Tipo documento	Riserva	Documento
Descrizione in italiano*	NO	TEC078BIT-descrizione.pdf.p7m hash: 6938ad60375e13dd9b6923623a463dc1
Rivendicazioni	NO	TEC078BIT-rivendicazioni.pdf.p7m hash: 97bd51f43506111f2dc4ddb3a48b6385
Lettera di Incarico	NO	TEC078BIT-lettera d'incarico.pdf.p7m hash: 09c9e50131436ff4ec2545ca3a6eb08c

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Riassunto	NO	TEC078BIT-riassunto.pdf.p7m hash: 0c9a19405421f98dee6d4cf336846725
Disegni	NO	TEC078BIT-figure.pdf.p7m hash: 5a5129345bb663d5ad2a7d8d53059fce
Rivendicazioni in inglese	SI	hash:

PAGAMENTI

Tipo	Identificativo	Data
Bollo	01150649525110	21/11/2016

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IPR2024-00933

Domanda di brevetto per invenzione industriale dal titolo: "**Testa di misura per un'apparecchiatura di test di dispositivi elettronici con migliorate proprietà di filtraggio**"

a nome di: **TECHNOPROBE S.p.A.**

con sede in: **Cernusco Lombardone (Lecco)**

* * * * *

RIASSUNTO

Si descrive una testa di misura (20) comprendente una pluralità di sonde di contatto (21A, 21B, 21C) alloggiate in modo scorrevole in rispettive pluralità di fori guida (25A, 27A, 29A, 36A; 25B, 27B, 29B, 36B; 27C, 29C, 36C) realizzati in un supporto (22), piastriforme, la pluralità di sonde di contatto (21A, 21B, 21C) comprendendo almeno un primo gruppo di sonde di contatto (21A, 21B) che trasportano segnali di massa e di alimentazione (GND, PWR). Opportunamente, la testa di misura (20) comprende almeno un condensatore di filtraggio (30) avente almeno un reoforo (31) collegato elettricamente ad una porzione conduttiva (22A, 27A) realizzata sul supporto (22) ed includente almeno un foro guida di alloggiamento (25A, 29A) di una sonda di contatto (21A, 21B) del primo gruppo.

(Fig. 2A)

Ing. [illegible] FERRARI
N. Iscr. [illegible] 822 B

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DESCRIZIONE

Campo di applicazione

La presente invenzione fa riferimento ad una testa di misura per un'apparecchiatura di test di dispositivi elettronici.

L'invenzione riguarda in particolare, ma non esclusivamente, una testa di misura con migliorate prestazioni in frequenza e la descrizione che segue è fatta con riferimento a questo campo di applicazione con il solo scopo di semplificarne l'esposizione.

Arte nota

Come è ben noto, una testa di misura, nota anche come probe head, è essenzialmente un dispositivo atto a mettere in collegamento elettrico una pluralità di piazzole di contatto di una microstruttura, in particolare un dispositivo elettronico integrato su wafer, con corrispondenti canali di una apparecchiatura di test che ne esegue la verifica di funzionalità, in particolare elettrica, o genericamente il test.

Il test effettuato su dispositivi integrati serve in particolare a rilevare ed isolare dispositivi difettosi già in fase di produzione. Normalmente, le teste di misura vengono quindi utilizzate per il test elettrico dei dispositivi integrati su wafer prima del taglio o singolazione e del montaggio degli stessi all'interno di un package di contenimento di chip.

Una testa di misura include essenzialmente una pluralità di elementi di contatto mobili o sonde di contatto [contact probe] dotate di almeno una porzione di estremità o punta di contatto per una corrispondente pluralità di piazzole o pad di contatto di un dispositivo

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da testare, indicato anche come DUT (acronimo dall'inglese: "Device Under Test"). Con i termini estremità o punta si indica qui e nel seguito una porzione d'estremità, non necessariamente appuntita.

E' in particolare noto che l'efficacia e l'affidabilità di un test di misura dipende, tra gli altri fattori, anche dalla realizzazione di un buon collegamento elettrico tra dispositivo e apparecchiatura di test, e quindi, dallo stabilirsi di un ottimale contatto elettrico sonda/piazzola.

Tra le tipologie di teste di misura utilizzate nel settore della tecnica qui considerato per il test dei circuiti integrati, largamente diffuse sono le teste di misura denominate a sonde verticali ed indicate con il termine anglosassone "vertical probe head". Una testa di misura a sonde verticali comprende essenzialmente una pluralità di sonde di contatto trattenute da almeno una coppia di piastre o guide, sostanzialmente piastriformi e parallele tra loro. Tali guide sono dotate di appositi fori e poste ad una certa distanza fra loro in modo da lasciare una zona libera o zona d'aria per il movimento e l'eventuale deformazione delle sonde di contatto. La coppia di guide comprende in particolare una guida superiore [upper die] ed una guida inferiore [lower die], entrambe provviste di fori guida entro cui scorrono assialmente le sonde di contatto, normalmente formate da fili di leghe speciali con buone proprietà elettriche e meccaniche.

Il buon collegamento fra le sonde e le piazzole di contatto del dispositivo da testare è anche in tal caso assicurato dalla pressione della testa di misura sul dispositivo stesso, le sonde di contatto, mobili entro i fori guida realizzati nelle guide superiore ed inferiore, subendo in

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occasione di tale contatto premente una flessione, all'interno della zona d'aria tra le due guide, ed uno scorrimento all'interno di tali fori guida.

E' noto altresì utilizzare teste di misura con sonde non vincolate in maniera fissa, ma tenute interfacciate ad una interfaccia, a sua volta connessa all'apparecchiatura di test: si parla di teste di misura a sonde non bloccate.

In questo caso, le sonde di contatto presentano anche una ulteriore porzione di estremità o testa di contatto verso una pluralità di piazzole o pad di contatto di tale interfaccia. Il buon contatto elettrico tra sonde e interfaccia da viene assicurato in maniera analoga al contatto con il dispositivo da testare mediante la pressione delle sonde sulle piazzole di contatto della interfaccia.

Testa di misura ed interfaccia sono comprese in una cosiddetta scheda di misura [probe card] che costituisce la porzione terminale di una apparecchiatura di test di dispositivi integrati su wafer.

Nella sua forma più generale una scheda di misura, indicata complessivamente e schematicamente con 10 in Figura 1, comprende una testa di misura 1, nell'esempio di figura a sonde verticali non vincolate. La testa di misura 1 comprende una pluralità di sonde di contatto 2 contenute in un corpo 3, a sua volta usualmente comprendente almeno una coppia di supporti piastriformi o guide dotate di rispettivi fori guida in grado di alloggiare in modo scorrevole le sonde di contatto 2 e non illustrate in quanto convenzionali.

Ogni sonda di contatto 2 ha un'estremità o punta di contatto

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2A che va in battuta su una piazzola di contatto di un dispositivo da testare (non illustrato), in particolare integrato su un wafer semiconduttore, effettuando così il contatto meccanico ed elettrico con tale dispositivo.

Inoltre, ogni sonda di contatto 2 presenta un'ulteriore estremità, nella pratica indicata come testa di contatto 2B, verso una pluralità di piazzole di contatto 4A di una interfaccia 4. Il buon contatto elettrico tra sonde e interfaccia viene assicurato in maniera analoga al contatto con il dispositivo da testare mediante la pressione delle sonde, in particolare delle rispettive teste di contatto 2B, sulle piazzole di contatto 4A della interfaccia 4.

Più in particolare, l'interfaccia 4 è utilizzata anche per effettuare una trasformazione spaziale tra la distribuzione delle piazzole di contatto 4A disposte in corrispondenza di una sua prima faccia F4a, indicata anche come "probe side", su cui vanno in appoggio le teste di contatto 2B delle sonde di contatto 2 e corrispondenti piazzole di contatto 4B disposte in corrispondenza di una seconda e opposta faccia F4b, indicata anche come "tester side", dell'interfaccia 4, in particolare per il collegamento con la scheda stampata 5 o PCB (acronimo dall'inglese: "Printed Circuit Board") di collegamento con l'apparecchiatura di test.

In base alla sua precipua funzione di effettuare una trasformazione spaziale delle piazzole o pad di contatto, con in particolare un rilascio dei vincoli dimensionali legati alle distanze tra pad, indicata come pitch, delle più recenti tecnologie, l'interfaccia 4 è

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anche usualmente indicata come space trasformer. In altre parole, grazie all'utilizzo dell'interfaccia 4 è possibile realizzare piazzole di contatto 4B tester side con pitch maggiore delle piazzole di contatto 4A probe side.

L'operazione di trasformazione spaziale all'interno dell'interfaccia 4 viene effettuata utilizzando una pluralità di tracce o track conduttive 6, in particolare metalliche, in grado di effettuare il routing dei segnali dalle piazzole di contatto 4A probe side alle piazzole di contatto 4B tester side e da queste ultime, mediante opportune strutture di contatto elettrico 7, quali ball, pin o colonne (pillar) conduttivi, per citarne alcuni, di collegarsi alla scheda PCB 5. Anche all'interno della scheda PCB 5 viene effettuato il routing dei segnali, tramite ulteriori tracce o track conduttive 8, in particolare metalliche, per portare gli stessi all'esterno della scheda di misura 10 e quindi all'apparecchiatura di test. Le tracce o track conduttive 6 e 8 possono essere nella pratica anche interi piani conduttivi.

Le schede di misura note comprendono inoltre opportuni condensatori di filtraggio 9. Più in particolare, è noto utilizzare condensatori di filtraggio 9 di tipo ceramico, includenti un corpo isolante ceramico 9c ed opportuni reofori metallici 9r ai suoi lati, a costituire le armature dei condensatori stessi.

Tali condensatori di filtraggio sono comunemente posizionati sulla prima faccia F4a probe side della scheda di interfacciamento 4, all'esterno della testa di misura 1.

Per un miglior funzionamento dei condensatori di filtraggio 9,

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gli stessi devono essere posizionati il più vicino possibile alle sonde di contatto 2, in particolare alle sonde che portano i segnali di alimentazioni (Power) e di massa (Ground), a cui il filtraggio deve essere applicato, e più in particolare alle punte di contatto 2A di tali sonde.

Nelle più recenti tecnologie, alcuni condensatori di filtraggio 9 sono quindi disposti anche sulla seconda faccia F4b tester side, in porzioni opportunamente lasciate libere dalle strutture di contatto elettrico 7 in un'area Aph in corrispondenza della testa di misura 1.

In tal modo, i condensatori di filtraggio 9 sono maggiormente avvicinati alle sonde di contatto 2. Tale configurazione, tuttavia, impone un routing parallelo dei segnali di Power e Ground all'interno dell'interfaccia 4 che porti le stesse ai lati della stessa, al di fuori dell'area Aph corrispondente alla testa di misura 1.

Questo routing dei segnali di Power e Ground interno all'interfaccia 4 comporta la realizzazione di tracce o piani conduttivi 6 dall'area Aph ad una zona esterna o periferica dell'interfaccia 4, oltre alle tracce o piani conduttivi che portano i segnali di Power e Ground ai condensatori di filtraggio 9, disposti su diversi strati. Tutto ciò si traduce nella necessità di realizzare l'interfaccia 4 con un numero massiccio di strati, aumentandone lo spessore, con l'immediata ed ovvia conseguenza di allontanare i condensatori di filtraggio 9 stessi, disposti tester side, dalle relative sonde di contatto 2 di Power e Ground, in particolare dalle loro punte di contatto 2A, ed una riduzione delle relative capacità di filtraggio.

Quindi, anche le più recenti soluzioni per il posizionamento

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dei condensatori di filtraggio 9 tester side in un'area Aph corrispondente alla testa di misura 1, devono fare i conti con esigenze contrastanti e riescono ad ottenere solo un compromesso in termini di miglioramento prestazionale degli stessi.

Il problema tecnico che sta alla base della presente invenzione è quello di escogitare una testa di misura dotata di una pluralità di sonde di contatto per il collegamento con una apparecchiatura di test di dispositivi elettronici, in particolare integrati su wafer, avente caratteristiche strutturali e funzionali tali da consentire di superare le limitazioni e gli inconvenienti che tuttora affliggono le tecnologie note, in particolare permettendo di migliorare le prestazioni dei condensatori di filtraggio utilizzati per le sonde di contatto dei segnali di alimentazione e massa, posizionati in particolare all'interno della testa stessa.

Sommario dell'invenzione

L'idea di soluzione che sta alla base della presente invenzione è quella di realizzare su una o più guide opportune porzioni conduttive per il contatto con condensatori di filtraggio.

Sulla base di tale idea di soluzione il problema tecnico è risolto da una testa di misura comprendente una pluralità di sonde di contatto alloggiate in modo scorrevole in rispettive pluralità di fori guida realizzati in un supporto, piastriforme, tale pluralità di sonde di contatto comprendendo almeno un primo gruppo di sonde di contatto che trasportano segnali di massa e di alimentazione caratterizzata dal fatto di comprendere almeno un condensatore di filtraggio avente almeno un reoforo collegato elettricamente ad una porzione conduttiva

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realizzata sul supporto ed includente almeno un foro guida di alloggiamento di una sonda di contatto del primo gruppo.

Più in particolare, l'invenzione comprende le seguenti caratteristiche supplementari e facoltative, prese singolarmente o all'occorrenza in combinazione.

Secondo un altro aspetto dell'invenzione, la porzione conduttiva può essere collegata ad un primo riferimento di tensione scelto tra un riferimento di massa ed un riferimento di alimentazione, rispettivamente, ed il condensatore di filtraggio può comprendere un ulteriore reoforo connesso ad un secondo distinto riferimento di tensione, scelto tra un riferimento di alimentazione e di massa, rispettivamente.

Secondo un altro aspetto dell'invenzione, la porzione conduttiva può includere e mettere in collegamento elettrico una pluralità di fori guida di alloggiamento delle sonde di contatto del primo gruppo.

Ulteriormente, la porzione conduttiva può comprendere una porzione ortogonale che si estende almeno parzialmente all'interno dei fori guida di alloggiamento delle sonde di contatto del primo gruppo.

Secondo un altro aspetto ancora dell'invenzione, la testa di misura può comprendere distinte porzioni conduttive includenti distinte pluralità di fori guida di alloggiamento e collegate a distinti riferimenti di tensione, scelti tra riferimenti di alimentazione e di massa.

Ulteriormente, il supporto può comprendere almeno una sede di alloggiamento del condensatore di filtraggio, la porzione conduttiva

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estendendosi anche in corrispondenza di tale sede di alloggiamento per realizzare una connessione con l'almeno un reoforo del condensatore di filtraggio.

Più in particolare, la sede di alloggiamento del condensatore di filtraggio può estendersi nel supporto per una dimensione pari ad una corrispondente altezza del condensatore di filtraggio.

Secondo un altro aspetto dell'invenzione, il supporto può comprendere una prima porzione conduttiva realizzata in corrispondenza di una sua prima faccia ed una seconda porzione conduttiva realizzata in corrispondenza di una sua seconda ed opposta faccia, la sede di alloggiamento del condensatore di filtraggio essendo realizzata nel supporto in modo da mettere in comunicazione la prima e seconda faccia, il condensatore di filtraggio avendo un reoforo connesso alla prima porzione conduttiva ed un ulteriore reoforo connesso alla seconda porzione conduttiva, tali prima e seconda porzione conduttiva essendo connesse a rispettivi distinti riferimenti di tensione, scelti tra un riferimento di alimentazione e di massa.

Ulteriormente, la prima porzione conduttiva può includere almeno un primo foro guida di alloggiamento di una sonda di contatto del primo gruppo e la seconda porzione conduttiva può includere almeno un secondo foro guida di alloggiamento di una ulteriore sonda di contatto del primo gruppo, la prima porzione conduttiva essendo realizzata in modo tale da non contattare il secondo foro guida di alloggiamento essendo separata dallo stesso da un primo diaframma e la seconda porzione conduttiva essendo realizzata in modo tale da non

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contattare il primo foro guida di alloggiamento essendo separata dallo stesso da un secondo diaframma, tali primo e secondo diaframma garantendo l'isolamento della sonda di contatto (21A) e dell'ulteriore sonda di contatto dalla seconda e prima porzione conduttiva, rispettivamente.

Secondo un altro aspetto dell'invenzione, il supporto può comprendere almeno una coppia di guide, piastriformi e parallele tra loro, separate da una zona d'aria, ciascuna di tali guide essendo dotata di una pluralità di fori guida di alloggiamento delle sonde di contatto del primo gruppo ed una corrispondente pluralità di fori guida di passaggio di tali sonde di contatto, ciascuna delle guide avendo almeno porzione conduttiva includente almeno un foro guida di alloggiamento di una sonda di contatto del primo gruppo.

Più in particolare, le porzioni conduttive delle guide possono essere separate dai fori guida di passaggio delle sonde di contatto da diaframmi che garantiscono l'isolamento delle sonde di contatto dalle porzioni conduttive.

Ulteriormente, i fori guida di alloggiamento possono avere rispettivi primi diametri, preferibilmente uguali tra loro, e inferiori a rispettivi secondi diametri dei corrispondenti fori guida di passaggio, preferibilmente uguali tra loro, con il termine diametro intendendosi una dimensione trasversale massima di tali fori guida, anche di forma non circolare, in corrispondenza di una sezione trasversale presa in corrispondenza di un piano definito dalle guide.

Inoltre, le porzioni conduttive possono essere collegate ad un

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distinto riferimento di tensione scelto tra un riferimento di massa ed un riferimento di alimentazione.

Tali porzioni conduttive possono altresì essere realizzate su corrispondenti facce delle guide.

Secondo un altro aspetto dell'invenzione, almeno una porzione conduttiva può includere e mette in collegamento elettrico una pluralità di fori guida di alloggiamento delle sonde di contatto del primo gruppo.

Secondo un altro aspetto ancora dell'invenzione, una prima guida di tali guide può comprendere una sede di alloggiamento del condensatore di filtraggio, la porzione conduttiva della prima guida estendendosi anche in corrispondenza della sede di alloggiamento.

In particolare, il condensatore di filtraggio può essere inserito nella sede di alloggiamento ed in appoggio sulla porzione conduttiva della seconda guida.

Secondo un altro aspetto dell'invenzione, la prima e seconda guida possono comprendere ulteriormente una pluralità di fori guida di alloggiamento di sonde di contatto di un secondo gruppo di sonde di contatto che trasportano segnali operativi, le porzioni conduttive delle guide essendo separate dai fori guida di alloggiamento di sonde di contatto del secondo gruppo da opportuni diaframmi che garantiscono l'isolamento delle sonde di contatto del secondo gruppo dalle porzioni conduttive.

In particolare, le sonde di contatto del secondo gruppo possono essere parzialmente rivestite mediante materiale isolante, preferibilmente in una porzione in corrispondenza dei fori guida di

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alloggiamento.

Ulteriormente, le sonde di contatto del primo gruppo possono essere parzialmente rivestite mediante materiale isolante, preferibilmente in una porzione in corrispondenza dei fori guida di passaggio.

Secondo un altro aspetto dell'invenzione, il supporto può comprendere ulteriormente una guida intermedia inserita tra la coppia di guide occupando la zona d'aria, tale guida intermedia essendo dotata di una pluralità di fori guida di alloggiamento di sonde di contatto di un secondo gruppo di sonde di contatto che trasportano segnali operativi ed una corrispondente pluralità di fori guida di passaggio di sonde di contatto del primo gruppo, la guida intermedia essendo in contatto strisciante solamente con le sonde di contatto del secondo gruppo.

Più in particolare, i fori guida di alloggiamento delle sonde di contatto del secondo gruppo possono avere rispettivi primi diametri, preferibilmente uguali tra loro, e inferiori a rispettivi secondi diametri dei corrispondenti fori guida di passaggio, preferibilmente uguali tra loro, con il termine diametro intendendosi una dimensione trasversale massima di detti fori guida, anche di forma non circolare, in corrispondenza di una sezione trasversale presa in corrispondenza di un piano definito dalla guida intermedia.

Ulteriormente, la guida intermedia può comprendere una ulteriore sede di alloggiamento del condensatore di filtraggio, di dimensioni analoghe e posizionata in corrispondenza della sede di alloggiamento realizzata nella prima guida della coppia di guide.

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Secondo un altro aspetto dell'invenzione, il supporto è un supporto inferiore di una coppia di supporti di alloggiamento delle sonde di contatto, con inferiore intendendosi più vicino ad un dispositivo da testare integrato su wafer, il condensatore di filtraggio essendo così posizionato in prossimità di punte di contatto delle sonde di contatto atte ad andare in battuta su pad di contatto del dispositivo da testare.

Secondo un altro aspetto dell'invenzione, la testa di misura può comprendere una pluralità di condensatori di filtraggio.

Inoltre, secondo un altro aspetto ancora dell'invenzione, la porzione conduttiva può estendersi sostanzialmente su tutto il supporto e ricoprire una sua faccia, includendo e mettendo in collegamento un primo gruppo di fori guida di alloggiamento di sonde di contatto del primo gruppo, la porzione conduttiva comprendendo ulteriormente rispettive aree non conduttive in corrispondenza di fori guida di alloggiamento di sonde di contatto non appartenenti al primo gruppo.

Infine, secondo un ulteriore aspetto dell'invenzione, la testa di misura può comprendere sonde di contatto parzialmente rivestite mediante materiale isolante, preferibilmente in una porzione in corrispondenza di fori guida inclusi in porzioni conduttive a cui tali sonde di contatto non devono essere collegate elettricamente.

Le caratteristiche ed i vantaggi della testa di misura secondo l'invenzione risulteranno dalla descrizione, fatta qui di seguito, di un suo esempio di realizzazione dato a titolo indicativo e non limitativo con riferimento ai disegni allegati.

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Breve descrizione dei disegni

In tali disegni:

- la Figura 1 mostra schematicamente una scheda di misura dotata di condensatori di filtraggio ed atta a supportare una testa di misura a sonde verticali realizzata secondo la tecnica nota;
- la Figura 2A mostra schematicamente una testa di misura a sonde verticali realizzata secondo la presente invenzione;
- le Figure 2B e 2C mostrano schematicamente varianti di realizzazione della testa di misura di Figura 2A;
- le Figure 3A, 3B mostrano schematicamente una vista in pianta di varianti di realizzazione di un supporto della testa di misura delle Figure 2A-2C;
- la Figura 4 mostra schematicamente una ulteriore variante di realizzazione di una testa di misura a sonde verticali secondo la presente invenzione;
- le Figure 5A, 5B mostrano schematicamente una vista in pianta di un supporto della testa di misura di Figura 4;
- le Figure 6A-6C mostrano schematicamente ulteriori varianti di realizzazione di una testa di misura a sonde verticali secondo la presente invenzione; e
- la Figura 7 mostra schematicamente una vista in pianta di una variante di realizzazione del supporto della testa di misura di Figura 4.

Descrizione dettagliata

Con riferimento a tali figure, ed in particolare alla Figura 2A,

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con 20 è complessivamente indicata una testa di misura [probe head] dotata una pluralità di sonde di contatto per il test di dispositivi elettronici, in particolare integrati su wafer.

E' opportuno notare che le figure rappresentano viste schematiche della testa di misura secondo l'invenzione e non sono disegnate in scala, ma sono invece disegnate in modo da enfatizzare le caratteristiche importanti dell'invenzione.

Inoltre, i diversi aspetti dell'invenzione rappresentati a titolo esemplificativo nelle figure sono ovviamente combinabili tra loro ed intercambiabili da una forma di realizzazione ad un'altra.

In particolare, come illustrato in Figura 2A, la testa di misura 20 comprende una pluralità di sonde di contatto 21 di tipo verticale alloggiate in modo scorrevole in un supporto 22, sostanzialmente una scheda piastriforme. Più in particolare, la testa di misura 20 illustrata in Figura 2A comprende almeno un primo gruppo di sonde di contatto destinate a trasportare segnali di alimentazione e di massa verso un dispositivo da testare 23, in particolare integrato su wafer. Per semplicità di illustrazione, nella Figura 2A viene mostrata solo una sonda di contatto per ciascuna tipologia ed in particolare una sonda di massa 21A ed una sonda di alimentazione 21B.

Ogni sonda di contatto, in particolare la sonda di massa 21A e la sonda di alimentazione 21B illustrate, ha almeno un'estremità o punta di contatto, 24A e 24B, rispettivamente, che va in battuta su una corrispondente piazzola o pad di contatto 23A, 23B del dispositivo da testare 23, così da effettuare il contatto meccanico ed elettrico fra il

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dispositivo ed una apparecchiatura di test (non illustrata).

Come visto in relazione alla tecnica nota, ogni sonda di contatto può altresì comprendere un'ulteriore estremità o testa di contatto atta ad andare in battuta su una corrispondente piazzola o pad di contatto di una scheda di interfacciamento o space transformer, secondo una configurazione ben nota nel settore e non mostrata per semplicità di illustrazione.

Le sonde di contatto di massa 21A e di alimentazione 21B sono alloggiate in modo scorrevole in rispettivi fori guida di alloggiamento 25A, 25B realizzati nel supporto 22.

Come verrà descritto nel seguito, la testa di misura 20 comprende anche almeno un secondo gruppo di sonde di contatto, destinate a trasportare segnali operativi, in particolare segnali di ingresso/uscita tra l'apparecchiatura di test ed il dispositivo da testare 23.

È noto che la presenza di numerose sonde di contatto destinate al trasporto di segnali di massa, così come al trasporto di segnali di alimentazione, crea interferenze, causando quindi una rumorosità nei segnali di ingresso/uscita utilizzati per la verifica del dispositivo da testare, il che limita le prestazioni in frequenza della testa di misura.

Opportunamente, la testa di misura 20 è quindi dotata di elementi di filtraggio, in particolare condensatori di filtraggio 30, connessi a riferimenti di alimentazione di massa e di potenza.

Per ottimizzare l'effetto di filtraggio dei condensatori di

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filtraggio 30 e quindi ridurre al minimo le interferenze causate dalle sonde di contatto che trasportano i segnali di massa e di alimentazione, 21A e 21B, vantaggiosamente secondo la presente invenzione i condensatori di filtraggio 30 sono posizionati il più possibile vicino alle punte di contatto 24A, 24B di tali sonde, in particolare connessi ad almeno una porzione conduttiva realizzata direttamente sul supporto 22 delle sonde, in particolare una porzione conduttiva superficiale. In una forma preferita di realizzazione, la testa di misura 20 comprende una coppia di supporti per le sonde di contatto, come descritto in relazione alla tecnica nota, e tale supporto 22 è un supporto inferiore, ovvero è un supporto posizionato in prossimità del wafer comprendente il dispositivo da testare 23.

Il supporto 22, in particolare un suo core piastriforme 22C, è realizzato in un materiale non conduttivo, ad esempio in un materiale ceramico quale nitruro di silicio, oppure in un materiale vetroso o a base silicio, oppure in materiale poliammidico, oppure in qualunque altro materiale dielettrico adatto.

Vantaggiosamente secondo la presente invenzione, nella forma di realizzazione illustrata in Figura 2A, il supporto 22 presenta almeno una porzione conduttiva 22A opportunamente realizzata su un almeno una sua faccia Fa, ad esempio una sua faccia superiore con riferimento all'illustrazione di Figura. Tale porzione conduttiva può essere realizzata nella forma ad esempio di uno strato di metallizzazione depositato sul supporto 22 e definito fotolitograficamente oppure tramite laser. Inoltre, tale porzione conduttiva può essere fatta in un qualsiasi materiale

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conduttore, quale ad esempio metallico, in particolare scelto tra rame, oro, argento, palladio, rodio e loro leghe, per citarne alcuni.

Opportunamente, la porzione conduttiva 22A è realizzata in modo da includere almeno un foro guida di alloggiamento di una sonda di contatto, ad esempio un foro guida di alloggiamento 25A di una sonda di massa 21A, più preferibilmente una pluralità di fori guida di alloggiamento.

In sostanza, la porzione conduttiva 22A ricopre un'area del supporto 22 che include più fori guida di alloggiamento, in particolare fori guida di alloggiamento 25A delle sonde di massa 21A, tali fori guida di alloggiamento 25A essendo quindi messi in collegamento elettrico tra loro dalla porzione conduttiva 22A, che realizza così un piano conduttivo comune, in particolare un piano di massa comune, atto a collegare elettricamente i fori guida di alloggiamento 25A e quindi le sonde di massa 21A, tra loro e ad un riferimento di massa GND.

La porzione conduttiva 22A può estendersi anche all'interno dei fori guida di alloggiamento 25A delle sonde di massa 21A, in particolare presentando anche una porzione ortogonale 22Aw che riveste almeno parzialmente una parete interna di tali fori guida di alloggiamento 25A, come mostrato in figura. In tal modo, il collegamento elettrico tra la sonda di massa 21A e la porzione conduttiva 22A è realizzato anche tramite un contatto strisciante tra di essa e la porzione ortogonale 22Aw che riveste la parete interna dei fori guida di alloggiamento 25A in cui la sonda è alloggiata.

Vantaggiosamente secondo la presente invenzione, in

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corrispondenza di tale porzione conduttiva 22A è definita almeno una porzione di alloggiamento 33* per un condensatore di filtraggio 30.

Più in particolare, un tale condensatore di filtraggio 30 comprende un corpo, ad esempio di tipo ceramico, ed una coppia di reofori metallici disposti ai lati di tale corpo a realizzare le armature del condensatore. In alternativa, è altresì possibile utilizzare un condensatore a base silicio o un altro tipo di condensatore discreto di dimensioni adatte all'alloggiamento nella testa di misura 20.

Vantaggiosamente secondo la presente invenzione, almeno un reoforo 31 del condensatore di filtraggio 30 è connesso elettricamente alla porzione conduttiva 22A del supporto 22 e quindi al riferimento di massa GND.

Più in particolare, il condensatore di filtraggio 30 è alloggiato in corrispondenza della porzione di alloggiamento 33* definita nella porzione conduttiva 22A. Il condensatore di filtraggio 30 è in particolare appoggiato alla porzione conduttiva 22A in corrispondenza di tale porzione di alloggiamento 33*. Tale condensatore di filtraggio 30 presenta un ulteriore reoforo 32 opportunamente connesso ad un riferimento di alimentazione PWR.

Vantaggiosamente secondo la presente invenzione, il condensatore di filtraggio 30 è in collegamento elettrico con una pluralità di fori guida di alloggiamento di rispettive sonde di contatto, in particolare i fori guida di alloggiamento 25A delle sonde di massa 21A inclusi nella e messi in contatto dalla porzione conduttiva 22A.

In tal modo il condensatore di filtraggio 30 è in grado di

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filtrare il rumore per tutte le sonde di massa 21A connesse alla prima porzione conduttiva 22A.

Si sottolinea che il condensatore di filtraggio 30 è dimensionato in modo da essere alloggiato all'interno della testa di misura 20, in particolare appoggiato sul supporto 22, senza ostacolare il corretto funzionamento della stessa ed in particolare lo scorrimento delle sonde di contatto 21 nei rispettivi fori guida.

Più in particolare, è possibile utilizzare un condensatore di filtraggio discreto, di forma sostanzialmente parallelepipeda, come attualmente in commercio, ad esempio avente lunghezza e profondità comprese tra 0,1 mm e 0,4 mm, preferibilmente tra 0,125 mm e 0,3 mm e altezza compresa tra 0,2 mm e 0,7 mm, preferibilmente tra 0,25 mm e 0,6 mm.

E' ovviamente possibile realizzare la porzione conduttiva del supporto 22 in collegamento elettrico con un riferimento di potenza PWR, eventualmente comprendente una pluralità di fori guida di alloggiamento 25B di sonde di alimentazione 21B. Anche in tal caso, il condensatore di filtraggio 30 comprenderà un reoforo connesso elettricamente a tale porzione conduttiva e quindi al riferimento di potenza PWR ed un ulteriore reoforo in collegamento elettrico con un riferimento di massa GND.

Inoltre, è possibile realizzare nella testa di misura 20 una pluralità di condensatori di filtraggio 30 connessi a rispettive porzioni conduttive 22A realizzate sul supporto 20.

Secondo una variante di realizzazione illustrata

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schematicamente in Figura 2B, il supporto 22 comprende almeno una prima ed una seconda porzione conduttiva, 22A e 22B, rispettivamente, opportunamente realizzate su un almeno una sua faccia Fa, ad esempio una sua faccia superiore con riferimento all'illustrazione di Figura.

Anche in tal caso, le porzioni conduttive 22A e 22B possono essere realizzate nella forma ad esempio di strati di metallizzazione depositati sul supporto 22 e successivamente fotolitograficamente definiti e possono essere fatte in un qualsiasi materiale conduttore, quale ad esempio metallico, in particolare scelto tra rame, oro, argento, palladio, rodio e loro leghe, per citarne alcuni.

Più in particolare, il supporto 22 comprende almeno una prima porzione conduttiva 22A a sua volta includente almeno un foro guida di alloggiamento 25A di una sonda di massa 21A, ed una seconda porzione conduttiva 22B, a sua volta includente almeno un foro guida di alloggiamento 25B di una sonda di alimentazione 21B.

In una forma di realizzazione preferita, la prima porzione conduttiva 22A include una pluralità di fori guida di alloggiamento 25A di una pluralità di sonde di massa 21A e la seconda porzione conduttiva 22B include una pluralità di fori guida di alloggiamento 25B di una pluralità di sonde di alimentazione 21B.

In tal caso, la prima porzione conduttiva 22A ricopre un'area del supporto 22 che include più fori guida di alloggiamento 25A delle sonde di massa 21A, tali fori guida di alloggiamento 25A essendo quindi messi in collegamento elettrico tra loro dalla prima porzione conduttiva 22A, che realizza così un piano conduttivo comune, in particolare un

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piano di massa comune, atto a collegare elettricamente i fori guida di alloggiamento 25A e quindi le sonde di massa 21A, tra loro e ad un riferimento di massa GND.

Analogamente, la seconda porzione conduttiva 22B ricopre un'area del supporto 22 che include più fori guida di alloggiamento 25B delle sonde di alimentazione 21B, tali fori guida di alloggiamento 25B essendo così messi in collegamento elettrico tra loro dalla seconda porzione conduttiva 22B, che realizza così un piano conduttivo comune, in particolare un piano di alimentazione comune, atto a collegare elettricamente i fori guida di alloggiamento 25B e quindi le sonde di alimentazione 21B, tra loro e ad un riferimento di alimentazione PWR.

In una variante di realizzazione, tutte le sonde di massa 21A o di alimentazione 21B della testa di misura 20 sono collegate elettricamente tramite una stessa porzione conduttiva 22A, 22B. E' altresì possibile considerare il caso in cui distinte porzioni conduttive 22A e/o 22B sono collegate a diversi riferimenti di massa e/o alimentazione.

Opportunamente, la prima porzione conduttiva 22A può estendersi anche all'interno dei fori guida di alloggiamento 25A delle sonde di massa 21A, in particolare presentando anche una porzione ortogonale 22Aw che riveste almeno parzialmente una parete interna di tali fori guida di alloggiamento 25A. Analogamente, la seconda porzione conduttiva 22B può estendersi anche all'interno dei fori guida di alloggiamento 25B delle sonde di alimentazione 21B, in particolare presentando anche una porzione ortogonale 22Bw che riveste almeno

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parzialmente una parete interna di tali fori guida di alloggiamento 25B. In tal modo, il collegamento elettrico tra le sonde di massa 21A e di alimentazione 21B e la rispettiva porzione conduttiva 22A, 22B è realizzato anche tramite un contatto strisciante tra di esse e la rispettiva porzione ortogonale 22Aw e 22Bw che riveste la parete interna dei fori guida di alloggiamento 25A, 25B in cui le sonde sono alloggiate.

Si sottolinea tuttavia che, anche nel caso in cui le porzioni conduttive 22A, 22B non rivestano una tale parete interna dei fori guida 25A, 25B, il contatto elettrico è comunque garantito dallo spessore della porzione conduttiva 22A, 22B stessa, realizzata anche solo superficialmente sul supporto 22 su cui le sonde di massa 21A e di alimentazione 21B comunque strisciano durante il normale funzionamento della testa di misura 20, in particolare in occasione del contatto premente delle loro punte di contatto 24A, 24B sui pad di contatto 23A, 23B del dispositivo da testare 23.

Vantaggiosamente secondo la presente invenzione, la testa di misura 20 comprende inoltre almeno un condensatore di filtraggio 30 avente rispettivi reofori 31, 32 connessi ad una rispettiva porzione conduttiva 22A, 22B del supporto 22 e quindi in collegamento elettrico con i riferimenti di massa ed alimentazione.

Più in particolare, il condensatore di filtraggio 30 è alloggiato in corrispondenza di una porzione di alloggiamento 33* definita sul supporto 22 in modo da consentire il collegamento di un reoforo 31 alla prima porzione conduttiva 22A e quindi al riferimento di massa GND ed di un ulteriore reoforo 32 alla seconda porzione conduttiva 22B e quindi

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al riferimento di alimentazione PWR.

Opportunamente, nel caso di porzioni conduttive 22A, 22B che includono una pluralità di fori guida 25A, 25B che alloggiano una pluralità di sonde di massa 21A e di alimentazione 21B, il condensatore di filtraggio 30 è in grado di filtrare il rumore per tutte tali sonde di massa 21A e alimentazione 21B connesse alla prima ed alla seconda porzione conduttiva 22A, 22B. E' così possibile utilizzare un numero minore di condensatori e distribuirli più facilmente sul supporto 22; inoltre, si sottolinea che tali condensatori di filtraggio 30 sono realizzati in prossimità delle punte di contatto 24A, 24B delle sonde di contatto 21A e 21B, tale supporto 22 essendo opportunamente un supporto inferiore della testa di misura 20.

Secondo una ulteriore variante di realizzazione della testa di misura 20, il supporto 22 comprende una sede di alloggiamento 33 per il condensatore di filtraggio 30 ricavata nel suo corpo 22C, come schematicamente illustrato in Figura 2C. In tal caso, la prima porzione conduttiva 22A e la seconda porzione conduttiva 22B si estendono anche all'interno di tale sede di alloggiamento 33 per realizzare il collegamento con i reofori 31 e 32 del condensatore di filtraggio 30.

Opportunamente, la sede di alloggiamento 33 si estende nel supporto 22 per una prima dimensione H1 pari al 20-80% di uno spessore totale Sp del supporto 22. In una forma preferita di realizzazione, la prima dimensione H1 ha un valore compreso tra 100 μm e 300 μm, più preferibilmente pari a 200 μm mentre lo spessore totale Sp del supporto 22 ha un valore compreso tra 400 μm e 600 μm,

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più preferibilmente pari a 500 µm.

Opportunamente, la sede di alloggiamento 33 si estende nel supporto 22 per una dimensione almeno uguale ad una corrispondente dimensione del condensatore di filtraggio 30 in essa alloggiato, così che tale condensatore non sporga rispetto al supporto 22, in particolare dalla sua faccia superiore Fa.

Si sottolinea che la prima porzione conduttiva 22A e la seconda porzione conduttiva 22B rivestono comunque solamente una porzione superficiale del supporto 22, in particolare solo una parte della sua faccia superiore Fa, non estendendosi per tutta l'area di tale supporto, come schematicamente illustrato in Figura 3A. Questo permette il posizionamento e l'isolamento delle sonde di contatto per il trasporto dei segnali di ingresso/uscita, in particolare in aree del supporto 22 non rivestite dalle porzioni conduttive, come sarà spiegato nel seguito.

Più in particolare, la Figura 3A mostra una vista in pianta del supporto 22, in particolare della sua faccia Fa, in cui la prima porzione conduttiva 22A include e mette in collegamento elettrico una pluralità di fori guida 25A che alloggiano una pluralità di sonde di massa 21A ed una seconda porzione conduttiva 22B, la quale include mette in collegamento elettrico una pluralità di fori guida 25B, che alloggiano una pluralità di sonde di alimentazione 21B, ed è separata fisicamente ed elettronicamente dalla prima porzione conduttiva 22A da almeno un'area A del supporto 22, realizzato in materiale non conduttivo, dove è possibile realizzare ulteriori fori guida 25C per l'alloggiamento di

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sonde di contatto atte a trasportare segnali di ingresso/uscita. La prima porzione conduttiva 22A è in questo caso connessa ad un riferimento di massa GND mentre la secondo porzione conduttiva 22B è connessa ad un riferimento di alimentazione PWR.

Come già indicato, sia la prima porzione conduttiva 22A sia la seconda porzione conduttiva 22B rivestono solamente una porzione superficiale del supporto 22, in particolare solo una porzione della sua faccia Fa, avendo un'area inferiore ad un'area complessiva di tale faccia Fa. In tal modo, il supporto 22 non è rivestito interamente dalle porzioni conduttive 22A e 22B, ed è sempre presente almeno un'area non conduttiva A che separa tali porzioni conduttive e dove è possibile realizzare i fori guida 25C che alloggiano sonde di contatto di trasporto di segnali di ingresso/uscita, indicate anche come sonde di segnale.

È ovviamente possibile realizzare solamente una porzione conduttiva 22A o 22B sulla faccia Fa del supporto 22 oppure un numero maggiore di due di porzioni conduttive includenti rispettive pluralità di fori guida, che risultano così messi in contatto elettrico dalle rispettive porzioni conduttive. Analogamente, è possibile realizzare le porzioni conduttive in modo da comprendere tutte le sonde di contatto di un certo tipo, ad esempio una porzione conduttiva che includa tutte le sonde di massa 21A.

Alternativamente, in un'ulteriore forma di realizzazione della presente invenzione, una porzione conduttiva ricopre interamente il supporto 22 e include e mette in collegamento fori guida atti all'alloggiamento di sonde di contatto di un certo tipo, ad esempio sonde

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di massa, ad eccezione di opportune aree in cui sono realizzati fori guida atti all'alloggiamento di sonde di contatto di altro tipo, ad esempio sonde di alimentazione o sonde di segnale. In sostanza, tali aree sono ricavate per rimozione della porzione conduttiva di copertura del supporto 22 e sono quindi aree non conduttive.

In particolare, come illustrato schematicamente in Figura 3B, la prima porzione conduttiva 22A ricopre interamente la faccia Fa del supporto 22, ad eccezione di rispettive aree non conduttive A1 e A2 in cui sono realizzati i fori guida 25B e 25C di alloggiamento delle sonde di alimentazione 21B e delle sonde di segnale, rispettivamente. Come in precedenza, la prima porzione conduttiva 22A è quindi collegata ad un riferimento di massa GND. E' inoltre possibile realizzare, in corrispondenza di un'area non conduttiva A2, una seconda porzione conduttiva 22B che include e mette in contatto fori guida 25B di alloggiamento delle sonde di alimentazione 21B, tale seconda porzione conduttiva 22B essendo collegata ad un riferimento di alimentazione PWR.

Si sottolinea che le aree non conduttive possono anche essere nella forma di una pluralità di aree distinte, ciascuna realizzata solamente in corrispondenza di un foro guida che si desidera isolare elettricamente.

Secondo una variante di realizzazione, schematicamente illustrata in Figura 4, la prima porzione conduttiva 22A è realizzata in corrispondenza di una prima faccia Fa del supporto 22, in particolare una faccia superiore secondo il riferimento locale della figura, mentre la

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seconda porzione conduttiva 22B è realizzata in corrispondenza di una seconda ed opposta faccia Fb del supporto 22, in particolare una faccia inferiore secondo il riferimento locale della figura.

Opportunamente, il supporto 22 comprende in tal caso una sede di alloggiamento 33 del condensatore di filtraggio 30 che si estende lungo tutto lo spessore Sp del supporto 22 così da mettere in comunicazione le opposte facce Fa, Fb del supporto 22 stesso, consentendo in particolare un alloggiamento del condensatore di filtraggio 30 in verticale, sempre considerando il riferimento locale della Figura 4. In tal caso, la sede di alloggiamento 33 del condensatore di filtraggio 30 presenta una seconda dimensione H2 sostanzialmente pari allo spessore Sp del supporto 22. E' così possibile alloggiare in tale sede di alloggiamento 33 un condensatore di filtraggio 30 avente una corrispondente dimensione sostanzialmente uguale alla seconda dimensione H2 della sede di alloggiamento 33 oppure avente una dimensione inferiore a tale seconda dimensione H2, un opportuno materiale di riempimento conduttivo, quale una pasta conduttiva, essendo utilizzato per collegare tale condensatore di filtraggio 30 alla prima ed alla seconda porzione conduttiva 22A, 22B.

Più in particolare, come nell'esempio illustrato in Figura 4, il supporto 22 comprende la prima porzione conduttiva 22A realizzata sulla prima faccia Fa del supporto 22 in modo da comprendere anche una porzione ortogonale 22Aw che si estende all'interno dei fori guida di alloggiamento 25A di sonde di massa 21A, così connesse tra loro e ad un riferimento di massa GND e la seconda porzione conduttiva 22B

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realizzata sulla seconda faccia Fb del supporto 22 in modo da comprendere anche una porzione ortogonale 22Bw che si estende all'interno dei fori guida di alloggiamento 25B di sonde di alimentazione 21B, così connesse tra loro e ad un riferimento di alimentazione PWR. Tali prima e seconda porzione conduttiva 22A, 22B si estendono anche in corrispondenza della sede di alloggiamento 33 del condensatore di filtraggio 30, in particolare in contatto con rispettivi reofori 31 e 32 dello stesso.

Inoltre, opportunamente, la prima porzione conduttiva 22A è realizzata sulla prima faccia Fa in modo tale da non contattare i fori guida 25B di alloggiamento delle sonde di alimentazione 21B, più in particolare in modo da essere separata da tali fori guida 25B da un primo diaframma Df1, in particolare avente dimensioni maggiori di 5 μm. Analogamente, la seconda porzione conduttiva 22B è realizzata sulla seconda faccia Fb in modo tale da non contattare i fori guida 25A di alloggiamento delle sonde di massa 21A, più in particolare in modo da essere separata da tali fori guida 25A da un secondo diaframma Df2 avente dimensioni analoghe al primo diaframma Df1, ed in particolare avente dimensioni maggiori di 5 μm.

In una forma preferita di realizzazione, come illustrato schematicamente nelle Figure 5A e 5B, il supporto 22 è realizzato in modo da comprendere la prima porzione conduttiva 22A che ricopre interamente la prima faccia Fa del supporto 22, ad eccezione di rispettive aree non conduttive A1 e A2 in cui sono realizzati i fori guida 25B e 25C di alloggiamento delle sonde di alimentazione 21B e delle

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sonde di segnale, rispettivamente ed una seconda porzione conduttiva 22B che ricopre interamente la seconda faccia Fb del supporto 22, ad eccezione di rispettive aree non conduttive B1 e B2 in cui sono realizzati i fori guida 25A e 25C di alloggiamento delle sonde di massa 21A e delle sonde di segnale, rispettivamente. La prima porzione conduttiva 22A è quindi collegata ad un riferimento di massa GND mentre la seconda porzione conduttiva 22B è collegata ad un riferimento di alimentazione PWR.

Secondo una variante preferita di realizzazione, schematicamente illustrata in Figura 6A, il supporto 22 comprende una coppia di guide, piastriformi e parallele tra loro, in particolare una prima guida o guida inferiore 26 ed una seconda guida o guida superiore 27, i termini inferiore e superiore essendo utilizzati con riferimento alla rappresentazione in Figura, la guida superiore 27 essendo più distante dal dispositivo da testare 23 rispetto alla guida inferiore 26.

Il supporto 22 è in particolare realizzato in modo che la coppia di guide superiore 27 ed inferiore 26 siano separate da una zona d'aria 34 avente una altezza H3 pari al 10-40% dello spessore totale Sp del supporto 22 nel suo complesso, inteso in questa forma di realizzazione come l'assieme della coppia di guide superiore e inferiore, 27 e 26, e della zona d'aria 34. In una forma preferita di realizzazione, l'altezza H3 della zona d'aria 34 ha un valore compreso tra 80 μm e 500 μm, più preferibilmente pari a 250 μm mentre lo spessore totale Sp del supporto 22 ha un valore compreso tra 750 μm e 1250 μm, più preferibilmente

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pari a 800 μm. Le guide superiore e inferiore, 27 e 26, hanno rispettivi spessori Sp1, Sp2 con valore compreso tra 80 μm e 300 μm, più preferibilmente pari a 250 μm.

Tali guide superiore e inferiore, 27 e 26, comprendono ciascuna un core piastriforme in cui sono realizzate rispettive pluralità di fori guida per il passaggio o l'alloggiamento in modo scorrevole delle sonde di massa 21A e di alimentazione 21B. Più in particolare, nell'esempio dato a titolo illustrativo e non limitativo nella Figura 6A, la guida inferiore 26 comprende un core piastriforme 26C in cui è realizzata almeno una prima pluralità di fori guida 28A di passaggio delle sonde di massa 21A ed una seconda pluralità di fori guida 28B di alloggiamento delle sonde di alimentazione 21B. Analogamente, la guida superiore 27 comprende un core piastriforme 27C in cui è realizzata almeno una prima pluralità di fori guida 29A di alloggiamento delle sonde di massa 21A ed una seconda pluralità di fori guida 29B di passaggio delle sonde di alimentazione 21B.

Opportunamente, i fori guida 29A e 28B di alloggiamento delle sonde di massa 21A e di alimentazione 21B hanno rispettivi diametri D1A e D1B con valori compresi tra 20 μm e 70 μm, preferibilmente tra 30 μm e 40 μm, mentre i fori guida 29B e 28A di passaggio delle sonde di massa 21A e di alimentazione 21B hanno rispettivi diametri D2A e D2B, maggiori dei diametri D1A e D1B, rispettivamente, e in particolare con valori compresi tra 40 μm e 100 μm, preferibilmente tra 40 μm e 70 μm. Con il termine diametro si intende una dimensione trasversale massima di tali fori guida, anche di forma non circolare, in

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corrispondenza di una sezione trasversale dei fori presa in corrispondenza di un piano definito dalle guide. Preferibilmente, i diametri D1A e D1B dei fori guida 29A e 28B di alloggiamento sono sostanzialmente uguali tra loro; analogamente, come i diametri D2A e D2B dei fori guida 28A e 29B di passaggio sono sostanzialmente uguali tra loro.

Per semplicità di esposizione, si parlerà nel seguito di fori guida di alloggiamento, in particolare i fori guida 29A e 28B, e di fori guida di passaggio, in particolare i fori guida 29B e 28A.

Si sottolinea che il dimensionamento dei fori guida di alloggiamento e di passaggio garantisce che ogni sonda di contatto 21 sia in contatto con una sola porzione conduttiva realizzata su una guida, come nei precedenti esempi di realizzazione.

Le guide superiore e inferiore, 27 e 26, in particolare i loro core piastriformi 27C e 26C, sono realizzati in un materiale non conduttivo, ad esempio in un materiale ceramico quale nitruro di silicio, oppure in un materiale vetroso o a base silicio, oppure in materiale poliammidico, oppure in qualunque altro materiale dielettrico adatto.

Ulteriormente, la guida superiore 27 e la guida inferiore 26 presentano rispettive porzioni conduttive, realizzate su almeno una faccia di tali guide, ad esempio una rispettiva faccia superiore sempre con riferimento all'illustrazione di Figura 6A; le porzioni conduttive possono essere realizzate, ad esempio, nella forma di metallizzazioni opportunamente depositate e definite fotolitograficamente o mediante laser. Tali porzioni conduttive possono essere fatte in un qualsiasi

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materiale conduttore, quale ad esempio metallico, in particolare scelto tra rame, oro, argento, palladio, rodio e loro leghe, per citarne alcuni.

Più in particolare, la guida superiore 27 comprende almeno una prima porzione conduttiva 27A che include e mette in collegamento i fori guida 29A di alloggiamento delle sonde di massa 21A, che risultano in tal modo connesse tra loro e ad un riferimento di massa GND; in sostanza, la prima porzione conduttiva 27A realizza un piano conduttivo comune, in particolare un piano di massa comune atto a collegare elettricamente i fori guida 29A e quindi le sonde di massa 21A.

Analogamente, la guida inferiore 26 comprende almeno una seconda porzione conduttiva 26A che include e mette in collegamento i fori guida 28B di alloggiamento delle sonde di alimentazione 21B, che risultano in tal modo connesse tra loro e ad un riferimento di alimentazione PWR; anche in tal caso, la seconda porzione conduttiva 26A realizza così un piano conduttivo comune, in particolare un piano di alimentazione comune atto a collegare elettricamente i fori guida 28B e quindi le sonde di alimentazione 21B.

Si sottolinea nuovamente che, grazie al dimensionamento dei fori guida di alloggiamento e di passaggio, la sonda di massa 21A è in contatto solo con la prima porzione conduttiva 27A realizzata sulla guida superiore 27 e la sonda di alimentazione 21B è in contatto solamente con la seconda porzione conduttiva 26A realizzata sulla guida inferiore 26.

Inoltre, le porzioni conduttive 27A e 26A sono realizzate sulle rispettive guide 27 e 26 in modo tale da non contattare i fori guida 29B

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e 28A di alloggiamento delle sonde di alimentazione 21B e di massa 21A, rispettivamente, più in particolare in modo da essere separate da tali fori guida 29B, 28A da rispettivi diaframmi Dfa1, Dfa2, Dfb1, Dfb2, aventi in particolare dimensioni maggiori di 5 μm

E' altresì possibile utilizzare sonde di contatto 21A e 21B almeno parzialmente isolate, ad esempio mediante rivestimento in un materiale isolante, in particolare in una porzione delle stesse in corrispondenza dei fori guida di passaggio 28A e 29B, così da evitare collegamenti elettrici indesiderati tra tali sonde di contatto 21A e 21B e le porzioni conduttive 27A e 26A, rispettivamente. In tal caso, la presenza di diaframmi tra una porzione conduttiva ed i fori guida che non deve mettere in contatto potrebbe non essere necessaria.

In una forma di realizzazione, tutte le sonde di massa 21A o di alimentazione 21B della testa di misura 20 sono collegate elettricamente tramite una stessa porzione conduttiva 27A, 26A; in alternativa, solamente una parte di tali sonde di massa 21A o di alimentazione 21B possono essere collegate alla prima o alla seconda porzione conduttiva 27A, 26A, rispettivamente. E' inoltre possibile considerare il caso in cui distinte prime porzioni conduttive 27A e/o distinte seconde porzioni conduttive 26A sono collegate a distinti riferimenti di massa e/o alimentazione.

Anche in questa forma di realizzazione, sia la prima porzione conduttiva 27A della guida superiore 27 sia la seconda porzione conduttiva 26A della guida inferiore 26 rivestono solamente una porzione superficiale di tali guide, in particolare solo una porzione delle

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rispettive facce superiori, non estendendosi per tutta l'area di tali guide. Questo permette il posizionamento e l'isolamento delle sonde di contatto per il trasposto dei segnali di ingresso/uscita in aree del supporto 22, in particolare delle sue guide 26 e 27, non rivestite dalle porzioni conduttive.

Ulteriormente, il supporto 22 comprende almeno un condensatore di filtraggio 30 alloggiato in una sede di alloggiamento in esso sono realizzata e montato in configurazione verticale in modo da contattare la prima porzione conduttiva 27A della guida superiore 27 e la seconda porzione conduttiva 26A della guida inferiore 26, rispettivamente.

Nella forma di realizzazione illustrata in Figura 6A, il supporto 22 comprende un primo ed un secondo condensatore di filtraggio 30A e 30B alloggiati in rispettive sedi di alloggiamento 33A e 33B. Più in particolare, le sedi di alloggiamento 33A e 33B sono realizzate nel core 27C della guida superiore 27 e i condensatori di filtraggio 30A, 30B sono alloggiati in modo da appoggiare con uno dei loro reofori sulla seconda porzione conduttiva 26A della guida inferiore 26, in corrispondenza di rispettive porzioni di alloggiamento 33A* e 33B*, un ulteriore reoforo essendo in contatto con la prima porzione conduttiva 27A della guida superiore 27.

In una forma di realizzazione, tali sedi di alloggiamento 33A, 33B sono dimensionate in modo da alloggiare condensatori discreti disponibili in commercio ed occupano un'area approssimativamente quadrata in corrispondenza delle guide superiore 27 e inferiore 26, in

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particolare di lato compreso tra 0,1 mm e 0,4 mm, preferibilmente tra 0,125 mm e 0,3 mm.

La somma dell'altezza delle sedi di alloggiamento 33A, 33B, corrispondente allo spessore della guida superiore 27, e dell'altezza della zona d'aria 34 preferibilmente è uguale alla corrispondente dimensione H2 dei condensatori di filtraggio 30A, 30B che devono essere alloggiati tra le guide, ed ha un valore compreso tra 0,2 mm e 0,7 mm, preferibilmente tra 0,25 mm e 0,6 mm. In tal modo, i condensatori di filtraggio 30A, 30B, in appoggio sulla guida inferiore 26, non sporgono dalla faccia superiore della guida superiore 27.

In una forma preferita di realizzazione, la prima e la seconda porzione conduttiva 27A, 26A comprendono anche una porzione ortogonale 27Aw, 26Aw che riveste almeno parzialmente una parete interna dei fori guida 29A, 28B di alloggiamento delle sonde di massa 21A e delle sonde di alimentazione 21B, rispettivamente. In tal modo, il collegamento elettrico tra le sonde di massa 21A e di alimentazione 21B e la rispettiva prima o seconda porzione conduttiva 27A, 26A è realizzato tramite un contatto strisciante tra di esse e la porzione ortogonale 27Aw, 26Aw della corrispondente porzione conduttiva 27A, 26A che ricopre le pareti dei fori guida 29A, 28B in cui le sonde sono alloggiate.

Si sottolinea tuttavia che, anche nel caso di porzioni conduttive 27A, 26A che non rivestono una tale parete interna dei fori guida 29A, 28B, il contatto è comunque garantito dallo spessore di tali porzioni conduttive su cui le rispettive sonde di contatto comunque

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strisciano in occasione del loro movimento durante le operazioni di testing effettuate mediante la testa di misura 20.

Come già indicato, la testa di misura 20 comprende usualmente anche ulteriori sonde di contatto, in particolare sonde destinate a trasportare segnali operativi, in particolare segnali di ingresso/uscita tra l'apparecchiatura di test e il dispositivo da testare 23, indicate anche come sonde di segnale.. Negli esempi delle Figure 6B e 6C è illustrata a titolo di esempio una sola di queste sonde, indicata nel seguito come sonda di segnale 21C.

In tal caso, come nell'esempio di illustrato in Figura 6B, la guida superiore 27 e la guida inferiore 26 comprendono rispettivi fori guida di alloggiamento 29C e 28C di tali sonde di segnale 21C, aventi rispettivi diametri D1C con valori analoghi ai valori dei diametri D1A, D1C dei fori guida 29A e 28B di alloggiamento delle sonde di massa 21A e di alimentazione 21B ed in particolare con valori compresi tra 20 μm e 70 μm, preferibilmente tra 30 μm e 40 μm. Inoltre, come in precedenza, la prima e la seconda porzione conduttiva 27A, 26A sono realizzate sulla guida superiore 27 e sulla guida inferiore 26, rispettivamente, in modo da essere separate da tali fori guida di alloggiamento 29C, 28C delle sonde di segnale 21C da opportuni diaframmi Dfc1, Dfc2, in particolare aventi dimensioni maggiori di 5 μm.

E' altresì possibile utilizzare sonde di segnale 21C almeno parzialmente isolate, ad esempio mediante rivestimento in un materiale isolante, in particolare in una porzione delle stesse in corrispondenza dei fori guida di alloggiamento 29C, 28C, così da evitare collegamenti

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elettrici indesiderati tra tali sonde di segnale 21C e le porzioni conduttive 27A e 26A, rispettivamente. In tal caso, la presenza di diaframmi tra una porzione conduttiva ed i fori guida di passaggio potrebbe non essere necessaria.

In una variante di realizzazione illustrata in Figura 6C, il supporto 22 può comprendere altresì una guida intermedia 35, inserita tra la guida superiore 27 e la guida inferiore 26, e preferibilmente in contatto con esse. In sostanza, la guida intermedia 35 occupa la zona d'aria 34 tra le guide superiore 27 ed inferiore 26. In particolare, nella guida intermedia 35 sono realizzate una prima pluralità di fori guida 36A di passaggio delle sonde di massa 21A, una seconda pluralità di fori guida 36B di passaggio delle sonde di alimentazione 21B ed una terza pluralità di fori guida 36C di alloggiamento delle sonde di segnale 21C. Saranno ulteriormente previste corrispondenti pluralità di fori guida 29*C, 28*C di passaggio delle sonde di segnale 21C realizzate nella guida superiore 27 e nella guida inferiore 26, rispettivamente.

Come in precedenza, i fori guida 36C di alloggiamento delle sonda di contatto 21 hanno diametri D1C con valori analoghi ai valori dei diametri D1A, D1C dei fori guida 29A e 28B di alloggiamento delle sonde di massa 21A e di alimentazione 21B ed in particolare con valori compresi tra 20 μm e 70 μm, preferibilmente tra 30 μm e 40 μm, mentre i fori guida 36A, 36B di passaggio delle sonde di massa 21A e di alimentazione 21B hanno rispettivi diametri D2A e D2B, maggiori dei diametri D1A, D1B e D1C, e in particolare con valori compresi tra 40 μm e 100 μm, preferibilmente tra 40 μm e 70 μm. Ulteriormente, i fori

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guida 29*C, 28*C di passaggio delle sonde di segnale 21C realizzati nella guida superiore 27 e nella guida inferiore 26, rispettivamente, hanno diametri D2C sostanzialmente uguali tra loro ed ai diametri D2A e D2B degli altri fori guida di passaggio realizzati nelle guide superiore 27 e inferiore 26, in particolare con valori compresi tra 40 μm e 100 μm, preferibilmente tra 40 μm e 70 μm.

Come in precedenza, tale dimensionamento dei fori guida di alloggiamento e di passaggio garantisce che solo le sonde di massa 21A e le sonde di alimentazione 21B siano in contatto con una porzione conduttiva realizzata su una rispettiva guida, le sonde di segnale 21C essendo in contatto solamente con la guida intermedia 35, opportunamente realizzata in un materiale non conduttivo, ad esempio in un materiale ceramico quale nitruro di silicio, oppure in un materiale vetroso o a base silicio, oppure in materiale poliammidico, oppure in qualunque altro materiale dielettrico adatto.

In tal modo, le sonde di segnale 21C risultano isolate rispetto ai riferimenti di alimentazione e massa, in contatto strisciante solo con la guida intermedia 35 che non viene dotata di alcuna porzione conduttiva.

Come in precedenza, la guida superiore 27 e la guida inferiore 26 presentano rispettive porzioni conduttive, realizzate su un almeno una faccia di tali guide, ad esempio una rispettiva faccia superiore, atte a realizzare il contatto con i condensatori di filtraggio 30A, 30B, come spiegato in relazione alla Figura 6A.

Inoltre, nella guida intermedia 35 sono realizzate rispettive

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ulteriori sedi di alloggiamento 37A e 37B di tali condensatori di filtraggio 30A, 30B, di dimensioni analoghe alle e posizionate in corrispondenza delle sedi di alloggiamento 33A e 33B predisposte nella guida superiore 27. In particolare, la somma dell'altezza delle sedi di alloggiamento 33A, 33B e delle ulteriori sedi di alloggiamento 37A e 37B, corrispondente alla somma di uno spessore Sp1 della guida superiore 27 e di uno spessore Sp3 della guida intermedia 35 è preferibilmente uguale alla corrispondente dimensione H2 dei condensatori di filtraggio 30A, 30B che devono essere alloggiati tra le guide, ed ha un valore compreso tra 250 μm e 600 μm, preferibilmente 400 μm. In tal modo, i condensatori di filtraggio 30A, 30B, in appoggio sulla guida inferiore 26, non sporgono dalla faccia superiore della guida superiore 27.

Come in precedenza, i condensatori di filtraggio 30A, 30B sono in particolare in appoggio sulla guida inferiore 26, in corrispondenza di rispettive porzioni di alloggiamento 33A*, 33B* realizzate sulla seconda porzione conduttiva 26A, rispettivamente.

La guida inferiore 26 ha a sua volta uno spessore Sp2 con valore compreso tra 80 μm e 500 μm, più preferibilmente pari a 250 μm.

Inoltre, come in precedenza, la prima porzione conduttiva 27A è realizzata sulla prima guida 27 in modo tale da non contattare i fori guida 29B di passaggio delle sonde di alimentazione 21B ed i fori guida 29C di passaggio delle sonde di segnale 21C, più in particolare in modo da essere separata da tali fori guida da rispettivi diaframmi; analogamente, la seconda porzione conduttiva 26A è realizzata sulla

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seconda guida 26 in modo tale da non contattare i fori guida 28A di passaggio delle sonde di massa 21A ed i fori guida 28C di passaggio delle sonde di segnale 21C, più in particolare in modo da essere separata da tali fori guida da rispettivi diaframmi.

Anche in tal caso è possibile utilizzare sonde di contatto 21A, 21B e 21C almeno parzialmente isolate, in particolare in una porzione delle stesse in corrispondenza dei rispettivi fori guida di alloggiamento 28A, 29B, 28*C e 29*C, così da evitare collegamenti elettrici indesiderati tra tali sonde di contatto 21A, 21B e 21C e le porzioni conduttive 27A e 26A, rispettivamente. In tal caso, la presenza di diaframmi tra una porzione conduttiva ed i fori guida di passaggio potrebbe non essere necessaria.

E' opportuno sottolineare che, nelle applicazioni pratiche, il supporto 22 comprende numerosi fori guida che devono essere collegati mediante pattern complessi, i fori guida di alloggiamento delle sonde di massa e di alimentazione essendo spesso alternati. Opportunamente, utilizzando le porzioni conduttive realizzate sulle superfici di tale supporto 22, o di sue rispettive guide 26 e 27, è possibile realizzare tali collegamenti e consentire l'alloggiamento dei condensatori di filtraggio 30.

Più in particolare, con riferimento alla Figura 7, è schematicamente illustrato un supporto 22 comprendente una pluralità di fori guida di alloggiamento di sonde di contatto. Più in particolare, il supporto 22 comprende almeno un primo gruppo di fori guida, ad esempio fori guida 25A di alloggiamento di sonde di massa 21A,

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distribuiti secondo un primo pattern P1, nonché almeno un secondo gruppo di fori guida, ad esempio fori guida 25B di alloggiamento di sonde di alimentazione 21B, distribuiti secondo un secondo pattern P2.

Nella forma di realizzazione della Figura 7, il supporto 22 comprende una prima porzione conduttiva 22A realizzata su una sua prima faccia Fa, che include e mette in collegamento il primo gruppo di fori guida 25A del primo pattern P1 e comprende rispettive aree non conduttive A1, A2, A3 realizzate in corrispondenza di fori guida che non appartengono a tale primo pattern P1. Analogamente, il supporto 22 comprende una seconda porzione conduttiva 22B realizzata su una sua seconda faccia Fb, mostrata in trasparenza in figura, tale seconda porzione conduttiva 22B includendo e mettendo in collegamento il secondo gruppo di fori guida 25B del primo pattern P2 e comprendendo rispettive aree non conduttive B1, B2 realizzate in corrispondenza di fori guida che non appartengono a tale secondo pattern P2. La prima porzione conduttiva 22A è quindi in tal caso connessa ad un riferimento di massa GND e la seconda porzione conduttiva 22B ad un riferimento di alimentazione PWR.

Il supporto 22 comprende inoltre almeno un condensatore di filtraggio 30 disposto in modo da aver rispettivi reofori in contatto con la prima e la seconda porzione conduttiva 22A e 22B, rispettivamente.

Anche in tal caso, la testa di misura 20 può comprendere sonde di contatto parzialmente rivestite mediante materiale isolante, preferibilmente in una porzione in corrispondenza di fori guida inclusi in porzioni conduttive a cui tali sonde di contatto non devono essere

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collegate elettricamente.

In conclusione, vantaggiosamente secondo l'invenzione, si ottiene una testa di misura con migliorate prestazioni in termini di filtraggio dei segnali, in particolare dei segnali di alimentazioni (PWR) e massa (GND) e come tale in grado di migliorare le prestazioni in frequenza della scheda che la comprende, riducendone l'impedenza ad alta frequenza.

Si è in particolare potuto verificare che una scheda di misura comprendente la testa di misura secondo la presente invenzione consente di più che raddoppiare le prestazioni in frequenza rispetto alle soluzioni note.

Opportunamente, la testa di misura secondo la presente invenzione consente di alloggiare condensatori discreti disponibili sul mercato. Inoltre, la presenza di porzioni conduttive che connettono elettricamente gruppi di fori guida e quindi di sonde di contatto in essi inserite consente di diminuire il numero complessivo di condensatori necessario, e quindi la necessità di prevedere corrispondenti aree delle guide per l'inserimento di tali condensatori, aree che devono essere prive di fori guida.

Ovviamente alla testa di misura sopra descritta un tecnico del ramo, allo scopo di soddisfare esigenze contingenti e specifiche, potrà apportare numerose modifiche e varianti, tutte comprese nell'ambito di protezione dell'invenzione quale definito dalle seguenti rivendicazioni.

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RIVENDICAZIONI

1. Testa di misura (20) comprendente una pluralità di sonde di contatto (21A, 21B, 21C) alloggiate in modo scorrevole in rispettive pluralità di fori guida (25A, 27A, 29A, 36A; 25B, 27B, 29B, 36B; 28C, 29C, 36C) realizzati in un supporto (22), piastriforme, detta pluralità di sonde di contatto (21A, 21B, 21C) comprendendo almeno un primo gruppo di sonde di contatto (21A, 21B) che trasportano segnali di massa e di alimentazione (GND, PWR) caratterizzata dal fatto di comprendere almeno un condensatore di filtraggio (30) avente almeno un reoforo (31) collegato elettricamente ad una porzione conduttiva (22A, 27A; 22B, 26A) realizzata su detto supporto (22) ed includente almeno un foro guida di alloggiamento (25A, 29A; 25B, 28B) di una sonda di contatto (21A, 21B) di detto primo gruppo.

2. Testa di misura (20) secondo la rivendicazione 1, caratterizzata dal fatto che detta porzione conduttiva (22A, 27A; 22B, 26A) è collegata ad un primo riferimento di tensione scelto tra un riferimento di massa ed un riferimento di alimentazione (GND, PWR), rispettivamente, e dal fatto che detto condensatore di filtraggio (30) comprende un ulteriore reoforo (32) connesso ad un secondo distinto riferimento di tensione, scelto tra un riferimento di alimentazione e di massa (PWR, GND), rispettivamente.

3. Testa di misura (20) secondo la rivendicazione 1 o 2, caratterizzata dal fatto che detta porzione conduttiva (22A, 27A; 22B, 26A) include e mette in collegamento elettrico una pluralità di fori guida di alloggiamento (25A, 29A; 25B, 28B) di dette sonde di contatto (21A,

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21B) di detto primo gruppo.

4. Testa di misura (20) secondo una delle rivendicazioni precedenti, caratterizzata dal fatto che detta porzione conduttiva (22A, 27A; 22B, 26A) comprende una porzione ortogonale (22Aw, 27Aw; 22Bw, 26Aw) che si estende almeno parzialmente all'interno di detti fori guida di alloggiamento (25A, 29A; 25B, 28B) di dette sonde di contatto (21A, 21B) di detto primo gruppo.

5. Testa di misura (20) secondo una delle rivendicazioni precedenti, caratterizzata dal fatto di comprendere distinte porzioni conduttive includenti distinte pluralità di fori guida di alloggiamento e collegate a distinti riferimenti di tensione, scelti tra riferimenti di alimentazione e di massa (PWR, GND).

6. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detto supporto (22) comprende almeno una sede di alloggiamento (33) di detto condensatore di filtraggio (30), detta porzione conduttiva (22A, 22B) estendendosi anche in corrispondenza di detta sede di alloggiamento (33) per realizzare una connessione con detto almeno un reoforo (31) di detto condensatore di filtraggio (30).

7. Testa di misura (20) secondo la rivendicazione 6, caratterizzata dal fatto che detta sede di alloggiamento (33) di detto condensatore di filtraggio (30) si estende in detto supporto (22) per una dimensione (H1, H2) pari ad una corrispondente altezza di detto condensatore di filtraggio (30).

8. Testa di misura (20) secondo una delle rivendicazioni

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precedenti, caratterizzata dal fatto che detto supporto (22) comprende una prima porzione conduttiva (22A) realizzata in corrispondenza di una sua prima faccia (Fa) ed una seconda porzione conduttiva (22B) realizzata in corrispondenza di una sua seconda ed opposta faccia (Fb), detta sede di alloggiamento (33) di detto condensatore di filtraggio (30) essendo realizzata in detto supporto (22) in modo da mettere in comunicazione dette prima e seconda faccia (Fa, Fb), detto condensatore di filtraggio (30) avendo un reoforo (31) connesso a detta prima porzione conduttiva (22A) ed un ulteriore reoforo (32) connesso a detta seconda porzione conduttiva (22B), dette prima e seconda porzione conduttiva (22A, 22B) essendo connesse a rispettivi distinti riferimenti di tensione, scelti tra un riferimento di alimentazione e di massa (PWR, GND).

9. Testa di misura (20) secondo la rivendicazione 8, caratterizzata dal fatto che detta prima porzione conduttiva (22A) include almeno un primo foro guida di alloggiamento (25A) di una sonda di contatto (21A) di detto primo gruppo e detta seconda porzione conduttiva (22B) include almeno un secondo foro guida di alloggiamento (25B) di una ulteriore sonda di contatto (21B) di detto primo gruppo, detta prima porzione conduttiva (22A) essendo realizzata in modo tale da non contattare detto secondo foro guida di alloggiamento (25B) essendo separata dallo stesso da un primo diaframma (Df1) e detta seconda porzione conduttiva (22B) essendo realizzata in modo tale da non contattare detto primo foro guida di alloggiamento (25A) essendo separata dallo stesso da un secondo diaframma (Df2), detti primo e

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secondo diaframma (Df1, Df2) garantendo l'isolamento di detta sonda di contatto (21A) e detta ulteriore sonda di contatto (21B) da dette seconda e prima porzione conduttiva (22B, 22A), rispettivamente.

10. Testa di misura (20) secondo una delle rivendicazioni precedenti, caratterizzata dal fatto che detto supporto (22) comprende almeno una coppia di guide (27, 26), piastriformi e parallele tra loro, separate da una zona d'aria (34), ciascuna di dette guide (27, 26) essendo dotata di una pluralità di fori guida di alloggiamento (29A, 28B) di dette sonde di contatto (21A, 21B) di detto primo gruppo ed una corrispondente pluralità di fori guida di passaggio (29B, 28A) di dette sonde di contatto (21B, 21A), ciascuna di dette guide (27, 26) avendo almeno porzione conduttiva (27A, 26A) includente almeno un foro guida di alloggiamento (29A, 28B) di una sonda di contatto (21A, 21B) di detto primo gruppo.

11. Testa di misura (20) secondo la rivendicazione 10, caratterizzata dal fatto che dette porzioni conduttive (27A, 26A) di dette guide (27, 26) sono separate da detti fori guida di passaggio (29B, 28A) di dette sonde di contatto (21B, 21A) da diaframmi (Dfa1, Dfa2, Dfb1, Dfb2) che garantiscono l'isolamento di dette sonde di contatto (21B, 21A) da dette porzioni conduttive (27A, 26A).

12. Testa di misura (20) secondo la rivendicazione 10 o 11, caratterizzata dal fatto che detti fori guida di alloggiamento (29A, 28B) hanno rispettivi primi diametri (D1A, D1B), preferibilmente uguali tra loro, e inferiori a rispettivi secondi diametri (D2A, D2B) di detti corrispondenti fori guida di passaggio (28A, 29B), preferibilmente uguali

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tra loro, con il termine diametro intendendosi una dimensione trasversale massima di detti fori guida, anche di forma non circolare, in corrispondenza di una sezione trasversale presa in corrispondenza di un piano definito da dette guide (27, 26).

13. Testa di misura (20) secondo una delle rivendicazioni da 10 a 12, caratterizzata dal fatto che dette porzioni conduttive (27A, 26A) sono collegate ad un distinto riferimento di tensione scelto tra un riferimento di massa ed un riferimento di alimentazione (GND, PWR).

14. Testa di misura (20) secondo una delle rivendicazioni da 10 a 13, caratterizzata dal fatto che dette porzioni conduttive (27A, 26A) sono realizzate su corrispondenti facce di dette guide (27, 26).

15. Testa di misura (20) secondo una delle rivendicazioni da 10 a 14, caratterizzata dal fatto che almeno una porzione conduttiva (27A; 26A) include e mette in collegamento elettrico una pluralità di fori guida di alloggiamento (29A; 28B) di dette sonde di contatto (21A, 21B) di detto primo gruppo.

16. Testa di misura (20) secondo una delle rivendicazioni da 10 a 15, caratterizzata dal fatto che una prima guida (27) di dette guide (27, 26) comprende una sede di alloggiamento (33A; 33B) di detto condensatore di filtraggio (30A, 30B), detta porzione conduttiva (27A) di detta prima guida (27) estendendosi anche in corrispondenza di detta sede di alloggiamento (37A; 37B).

17. Testa di misura (20) secondo la rivendicazione 16, caratterizzata dal fatto che detto condensatore di filtraggio (30A, 30B) è inserito in detta sede di alloggiamento (37A; 37B) ed in appoggio su

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detta porzione conduttiva (26A) di detta seconda guida (26).

18. Testa di misura (20) secondo una delle rivendicazioni da 10 a 17, caratterizzata dal fatto che dette prima e seconda guida (27, 26) comprendono ulteriormente una pluralità di fori guida di alloggiamento (29C, 28C) di sonde di contatto (21C) di un secondo gruppo di sonde di contatto che trasportano segnali operativi, dette porzioni conduttive (27A, 26A) di dette guide (27, 26) essendo separate da detti fori guida di alloggiamento (29C, 28C) di sonde di contatto (21C) di detto secondo gruppo da opportuni diaframmi (Dfc1, Dfc2) che garantiscono l'isolamento di dette sonde di contatto (21C) di detto secondo gruppo da dette porzioni conduttive (27A, 26A).

19. Testa di misura (20) secondo la rivendicazione 18, caratterizzata dal fatto che dette sonde di contatto (21C) di detto secondo gruppo sono parzialmente rivestite mediante materiale isolante, preferibilmente in una porzione in corrispondenza di detti fori guida di alloggiamento (29C, 28C).

20. Testa di misura (20) secondo una delle rivendicazioni da 10 a 19, caratterizzata dal fatto che dette sonde di contatto (21A, 21B) di detto primo gruppo sono parzialmente rivestite mediante materiale isolante, preferibilmente in una porzione in corrispondenza di detti fori guida di passaggio (29B, 28A).

21. Testa di misura (20) secondo una delle rivendicazioni da 10 a 20, caratterizzata dal fatto che detto supporto (22) comprende ulteriormente una guida intermedia (35) inserita tra detta coppia di guide (27, 26) occupando detta zona d'aria (34), detta guida intermedia

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(35) essendo dotata di una pluralità di fori guida di alloggiamento (36C) di sonde di contatto (21C) di un secondo gruppo di sonde di contatto che trasportano segnali operativi ed una corrispondente pluralità di fori guida di passaggio (36A, 36B) di sonde di contatto (21A, 21B) di detto primo gruppo, detta guida intermedia (35) essendo in contatto strisciante solamente con dette sonde di contatto (21C) di detto secondo gruppo.

22. Testa di misura (20) secondo la rivendicazione 21, caratterizzata dal fatto che detti fori guida di alloggiamento (36C) di dette sonde di contatto (21C) di detto secondo gruppo hanno rispettivi primi diametri (D1C), preferibilmente uguali tra loro, e inferiori a rispettivi secondi diametri (D2C) di detti corrispondenti fori guida di passaggio (36A, 36B), preferibilmente uguali tra loro, con il termine diametro intendendosi una dimensione trasversale massima di detti fori guida, anche di forma non circolare, in corrispondenza di una sezione trasversale presa in corrispondenza di un piano definito da detta guida intermedia (35).

23. Testa di misura (20) secondo la rivendicazione 21 o 22, caratterizzata dal fatto che detta guida intermedia (35) comprende una ulteriore sede di alloggiamento (37A, 37B) di detto condensatore di filtraggio (30A, 30B), di dimensioni analoghe e posizionata in corrispondenza di detta sede di alloggiamento (33A, 33B) realizzata in detta prima guida (27) di detta coppia di guide (27, 26).

24. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detto supporto

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(22) è un supporto inferiore di una coppia di supporti di alloggiamento di dette sonde di contatto (21A, 21B, 21C), con inferiore intendendosi più vicino ad un dispositivo da testare (23) integrato su wafer, detto condensatore di filtraggio (30) essendo così posizionato in prossimità di punte di contatto di dette sonde di contatto (21A, 21B, 21C) atte ad andare in battuta su pad di contatto (23A, 23B) di detto dispositivo da testare (23).

25. Testa di misura (20) secondo una delle rivendicazioni precedenti, caratterizzata dal fatto di comprendere una pluralità di condensatori di filtraggio (30, 30A, 30B).

26. Testa di misura (20) secondo una delle rivendicazioni precedenti, caratterizzata dal fatto che detta porzione conduttiva (22A, 22B) si estende sostanzialmente su tutto detto supporto (22) e ricopre una sua faccia (Fa, Fb), includendo e mettendo in collegamento un primo gruppo di fori guida (25A, 25B) di alloggiamento di sonde di contatto (21A, 21B) di detto primo gruppo, detta porzione conduttiva (22A, 22B) comprendendo ulteriormente rispettive aree non conduttive (A1, A2, A3, B1, B2) in corrispondenza di fori guida di alloggiamento di sonde di contatto (21A, 21B, 21C) non appartenenti a detto primo gruppo.

27. Testa di misura (20) secondo una delle rivendicazioni precedenti, caratterizzata dal fatto di comprendere sonde di contatto (21A, 21B, 21B) parzialmente rivestite mediante materiale isolante, preferibilmente in una porzione in corrispondenza di fori guida inclusi in porzioni conduttive a cui dette sonde di contatto (21A, 21B, 21C) non

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devono essere collegate elettricamente.

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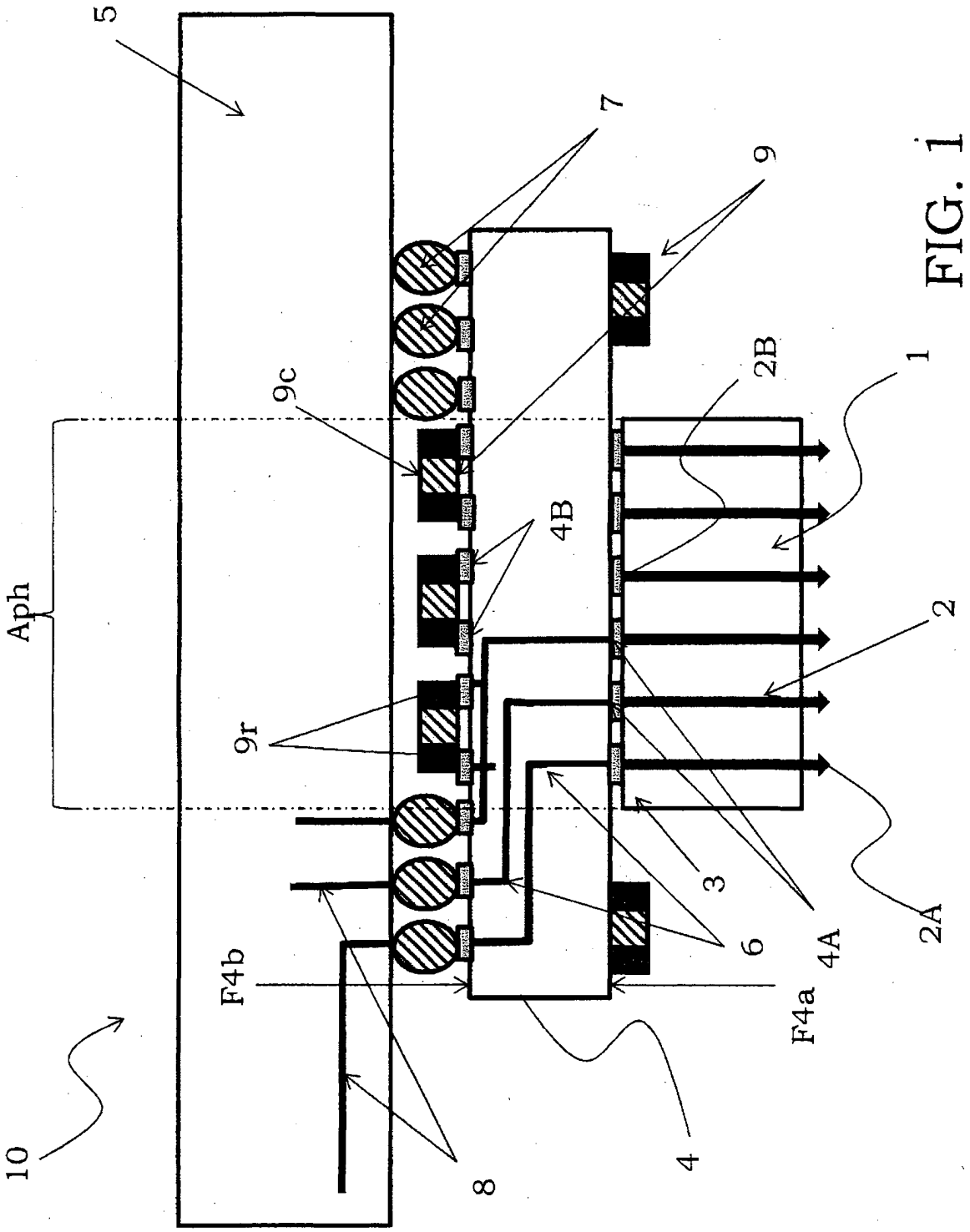


FIG. 1
ARTE NOTA

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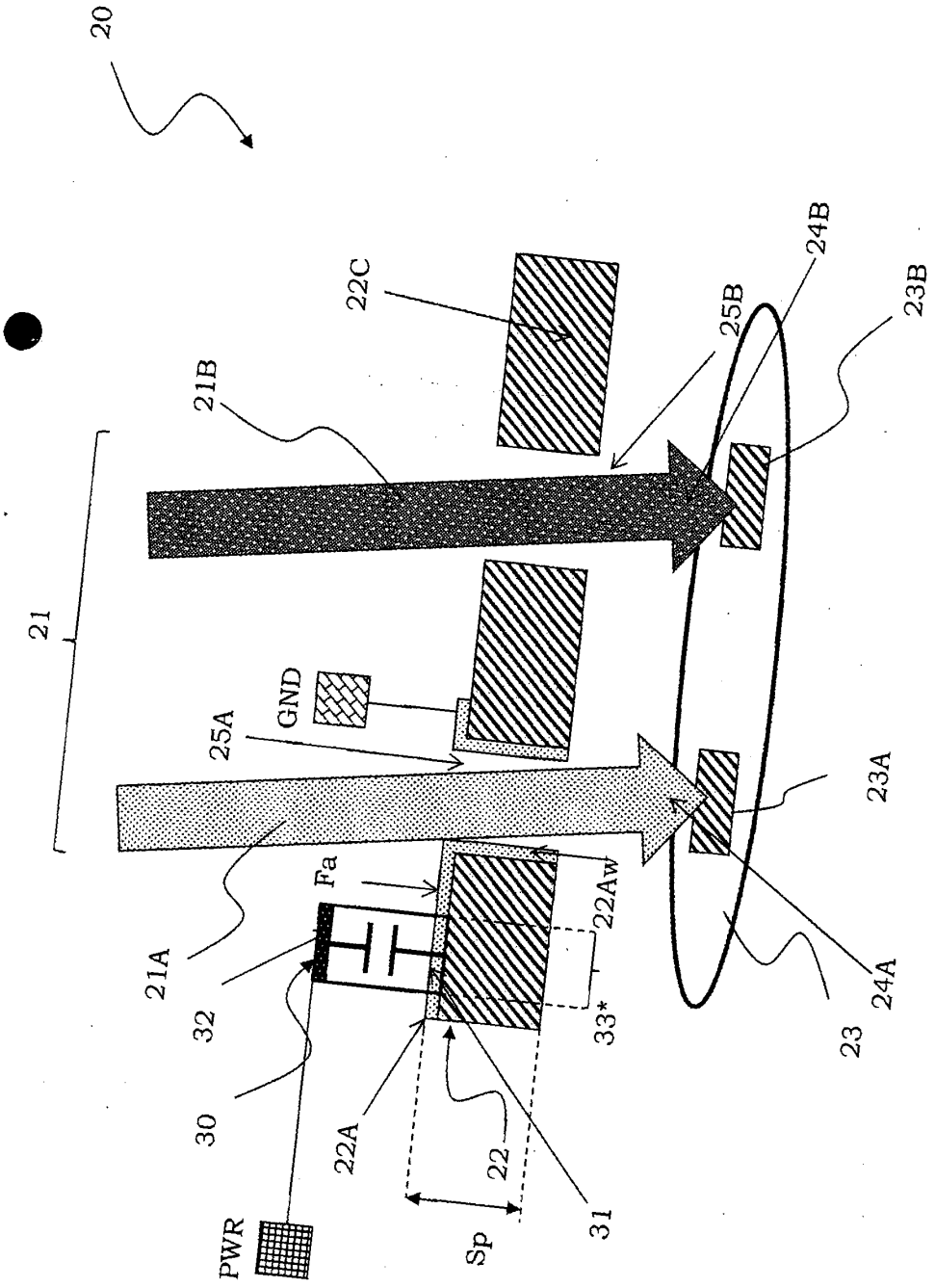

20
21
21B
22C
24B
25B
23B
GND
25A
23A
Fa
22Aw
21A
32
33*
24A
23
30
22A
22
31
PWR
Sp

FIG. 2A

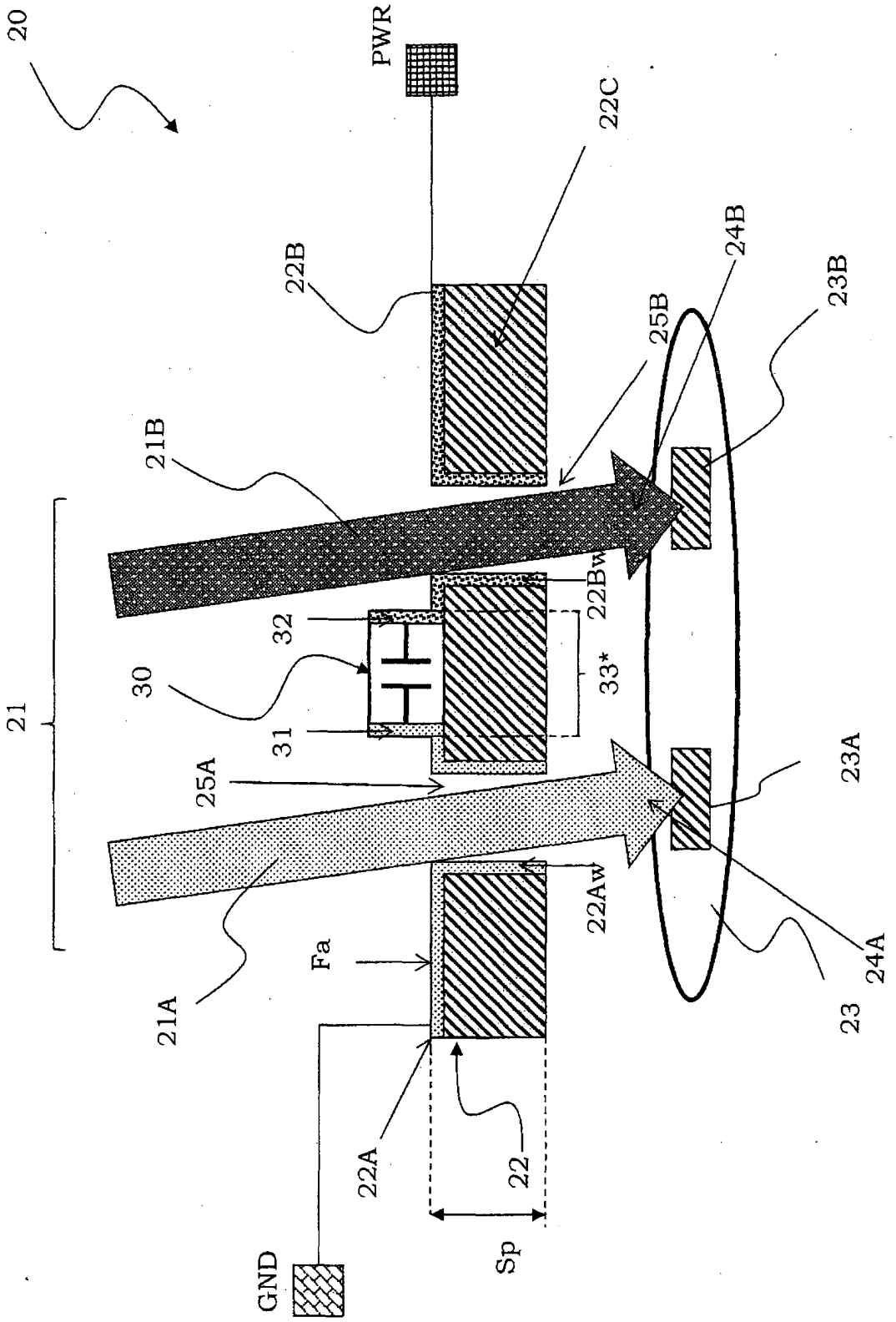


FIG. 2B

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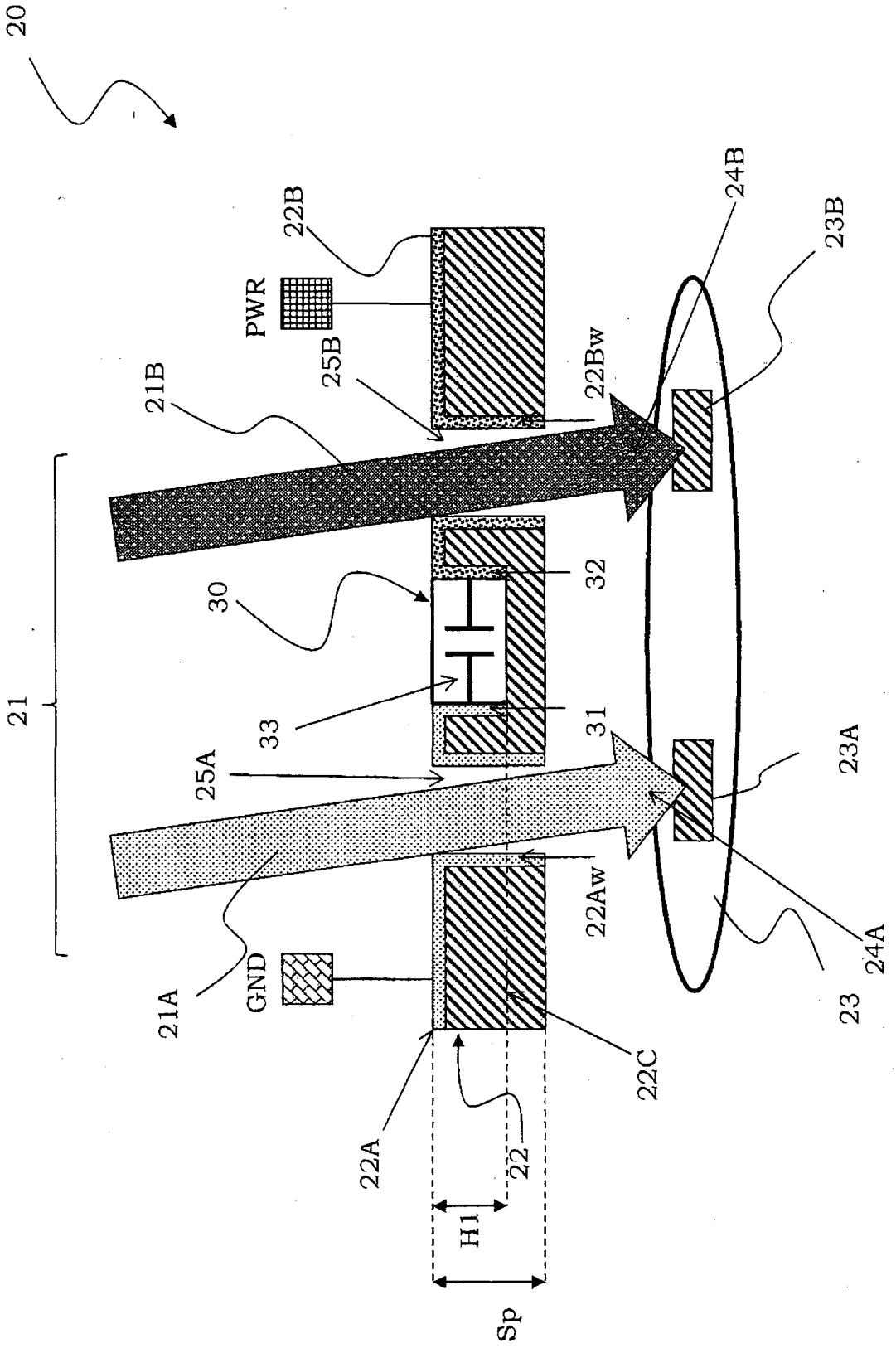


FIG. 2C

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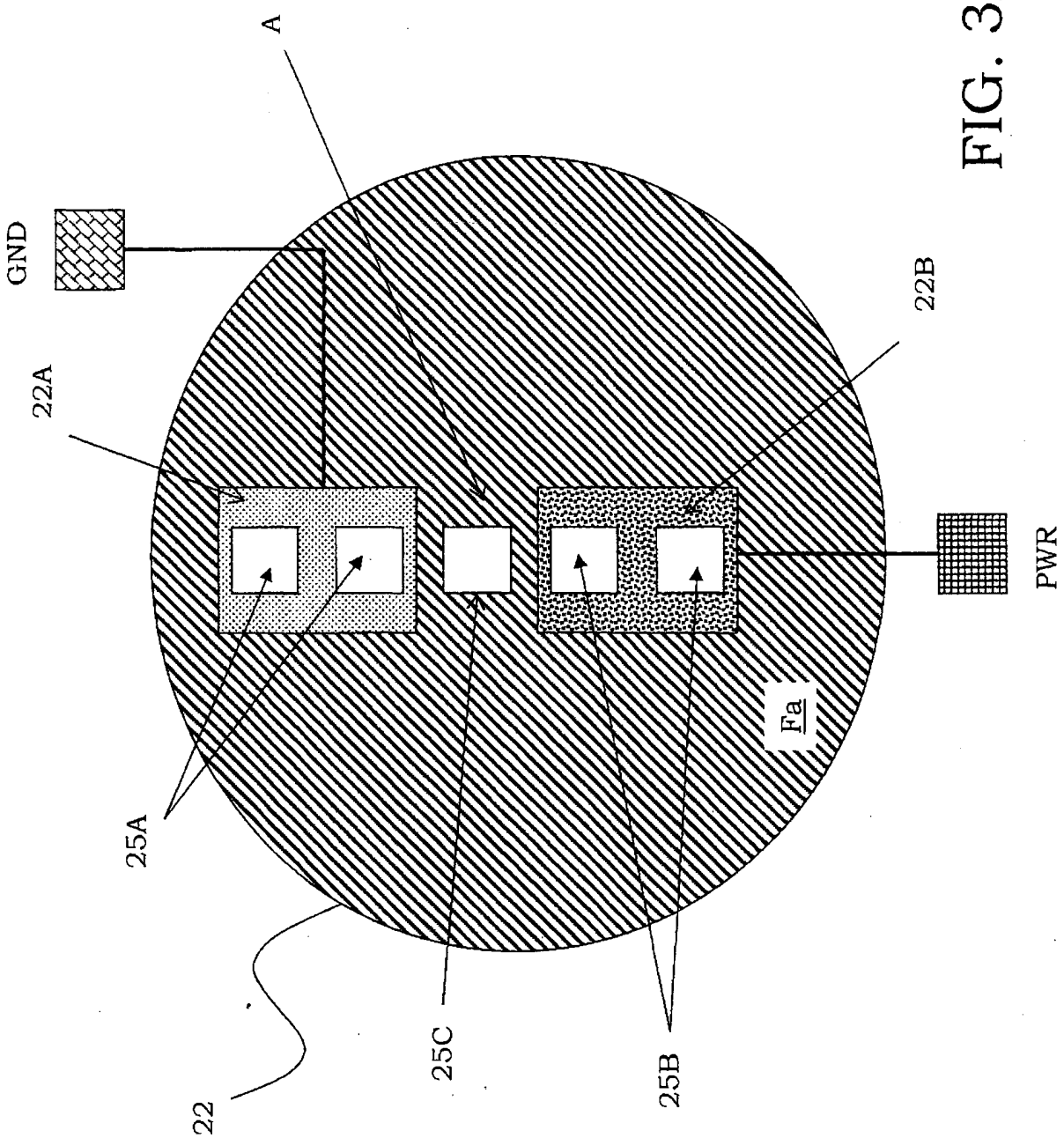


FIG. 3A

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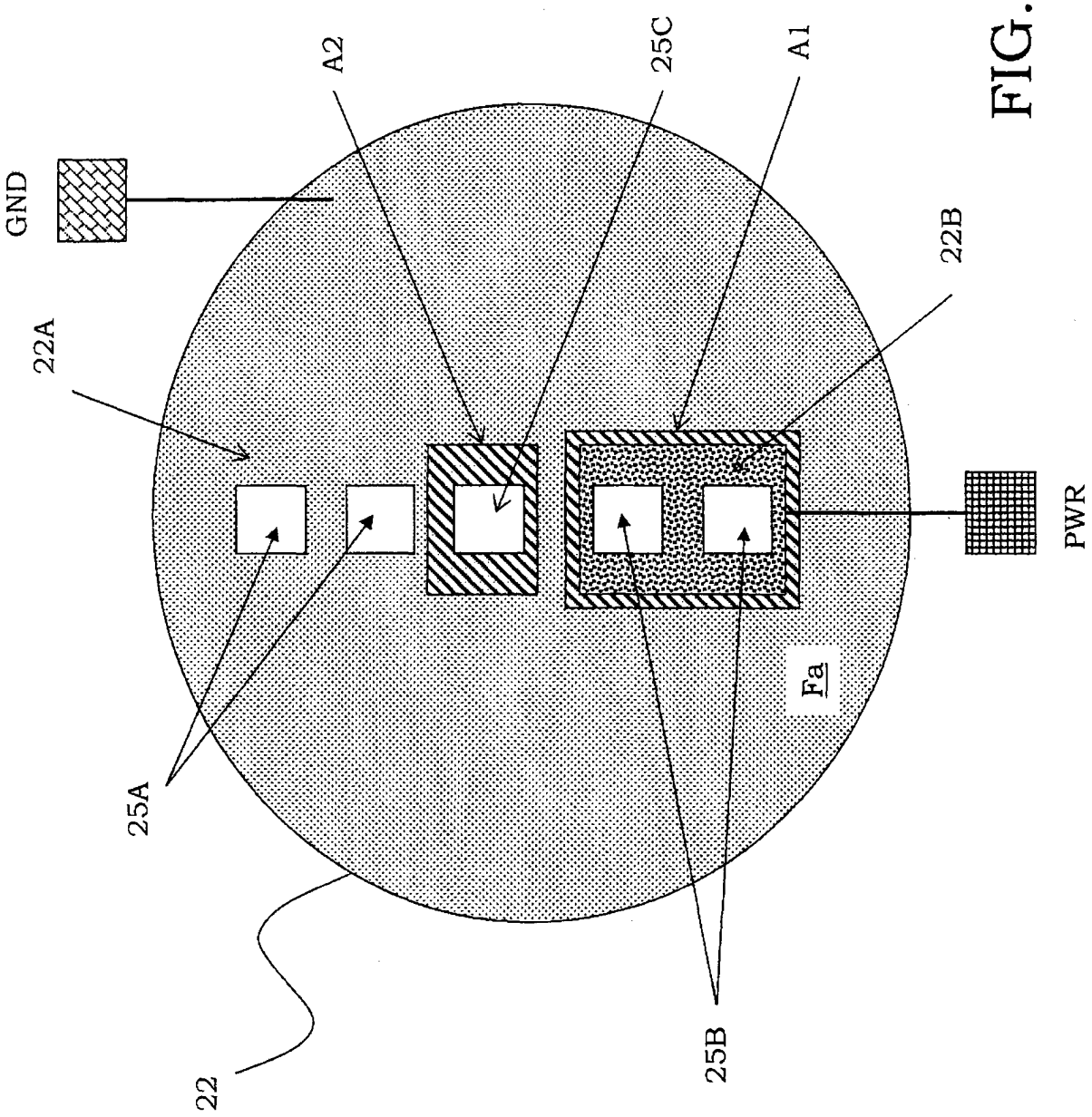


FIG. 3B

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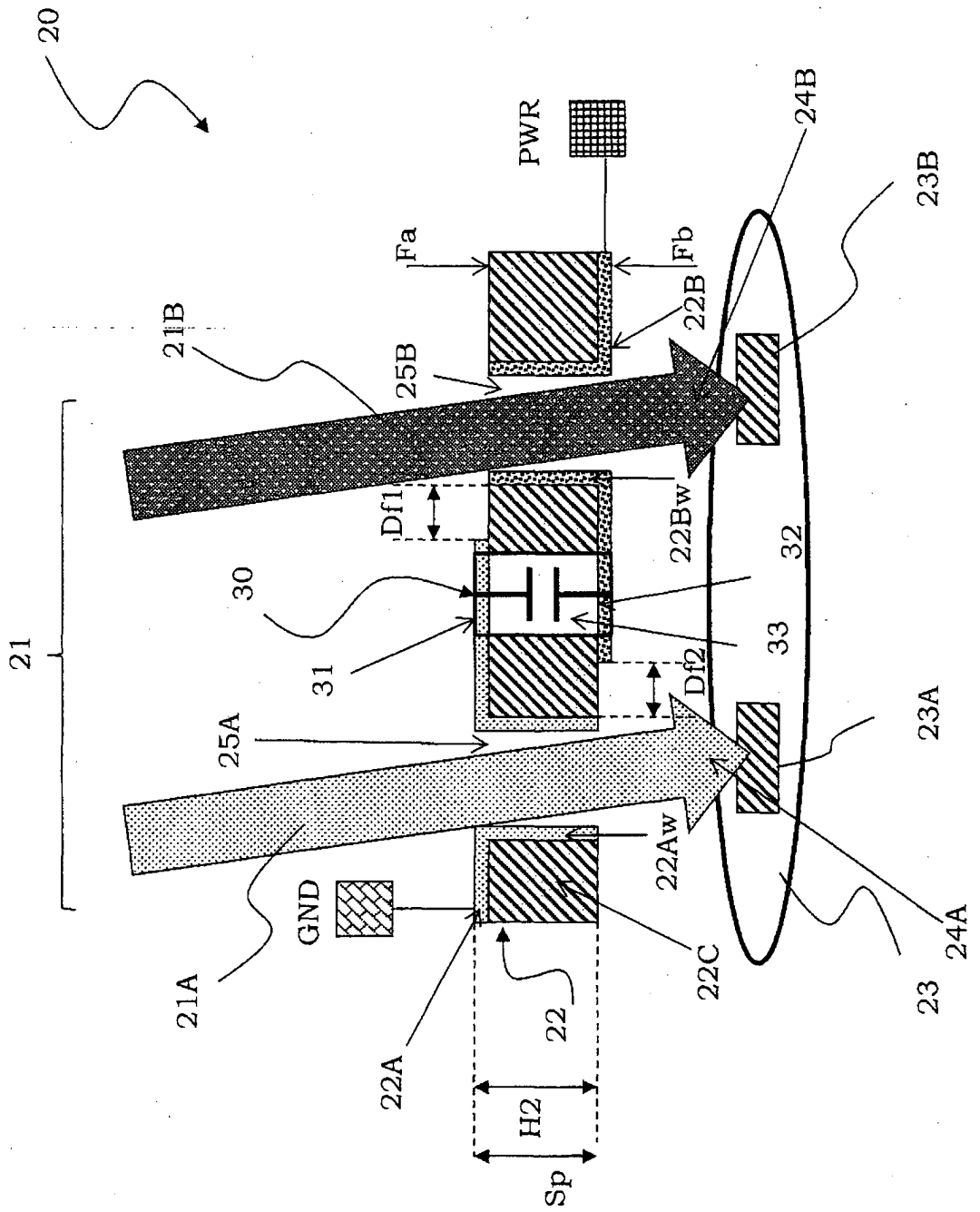


FIG. 4

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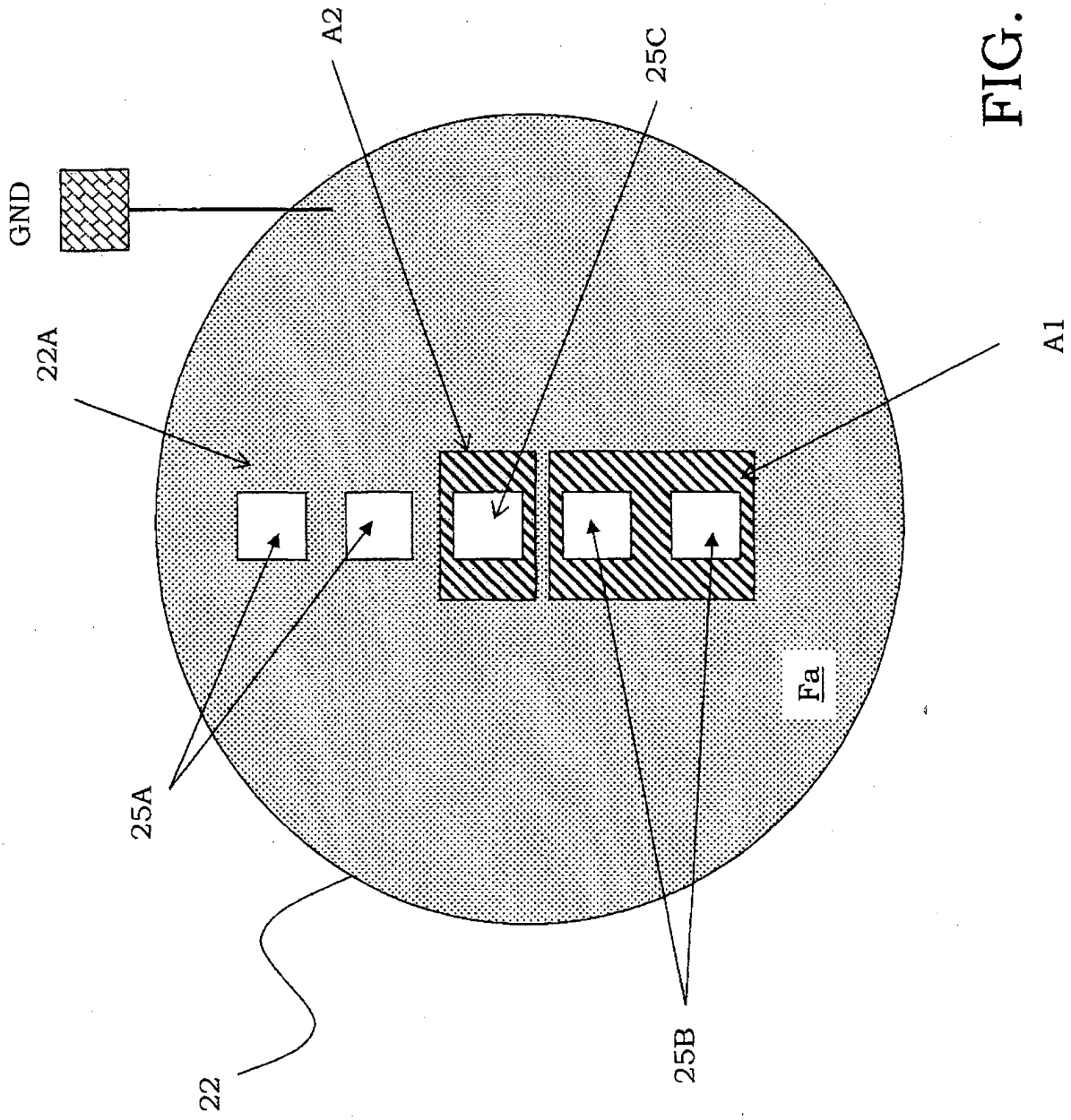


FIG. 5A

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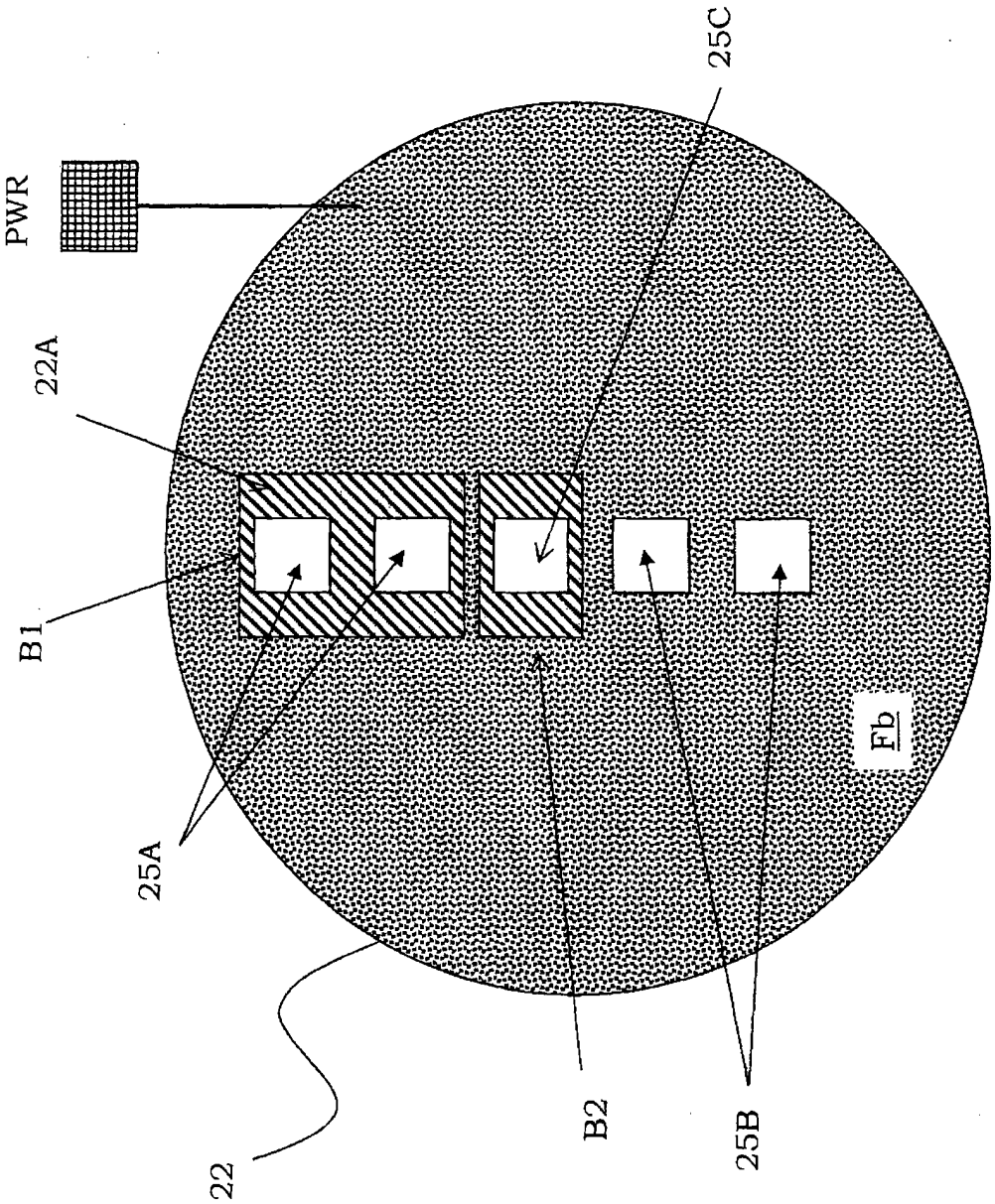


FIG. 5B

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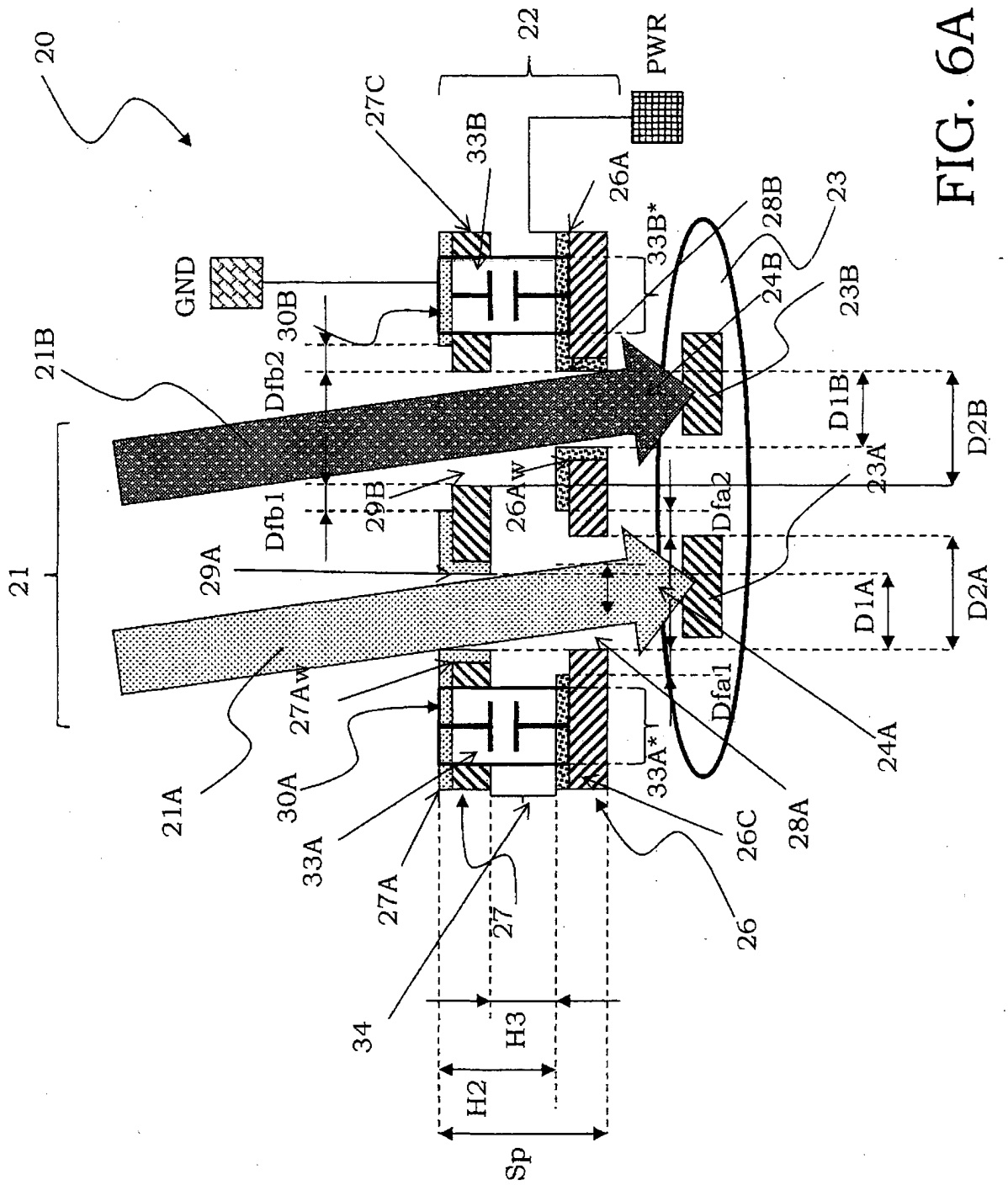


FIG. 6A

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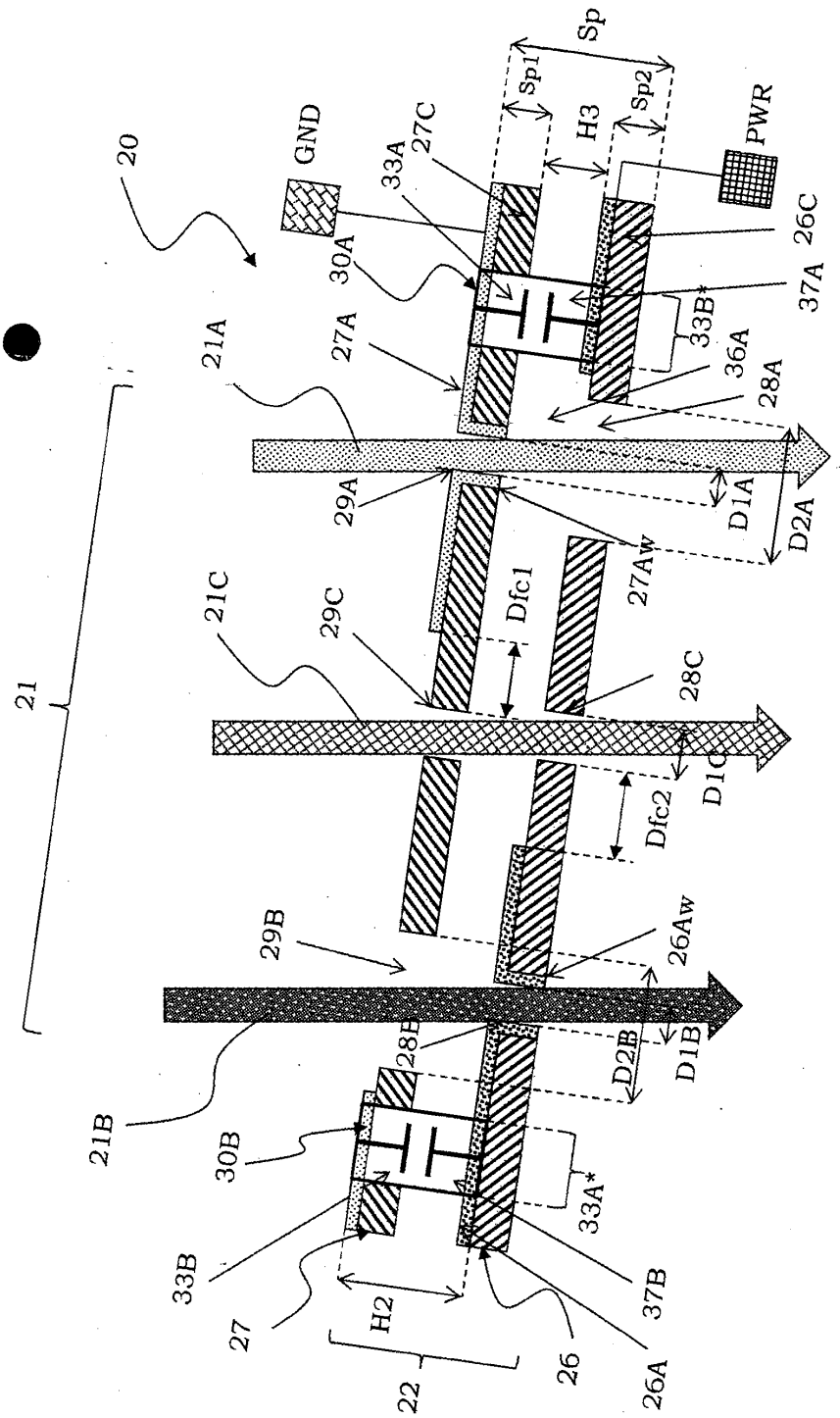


FIG. 6B

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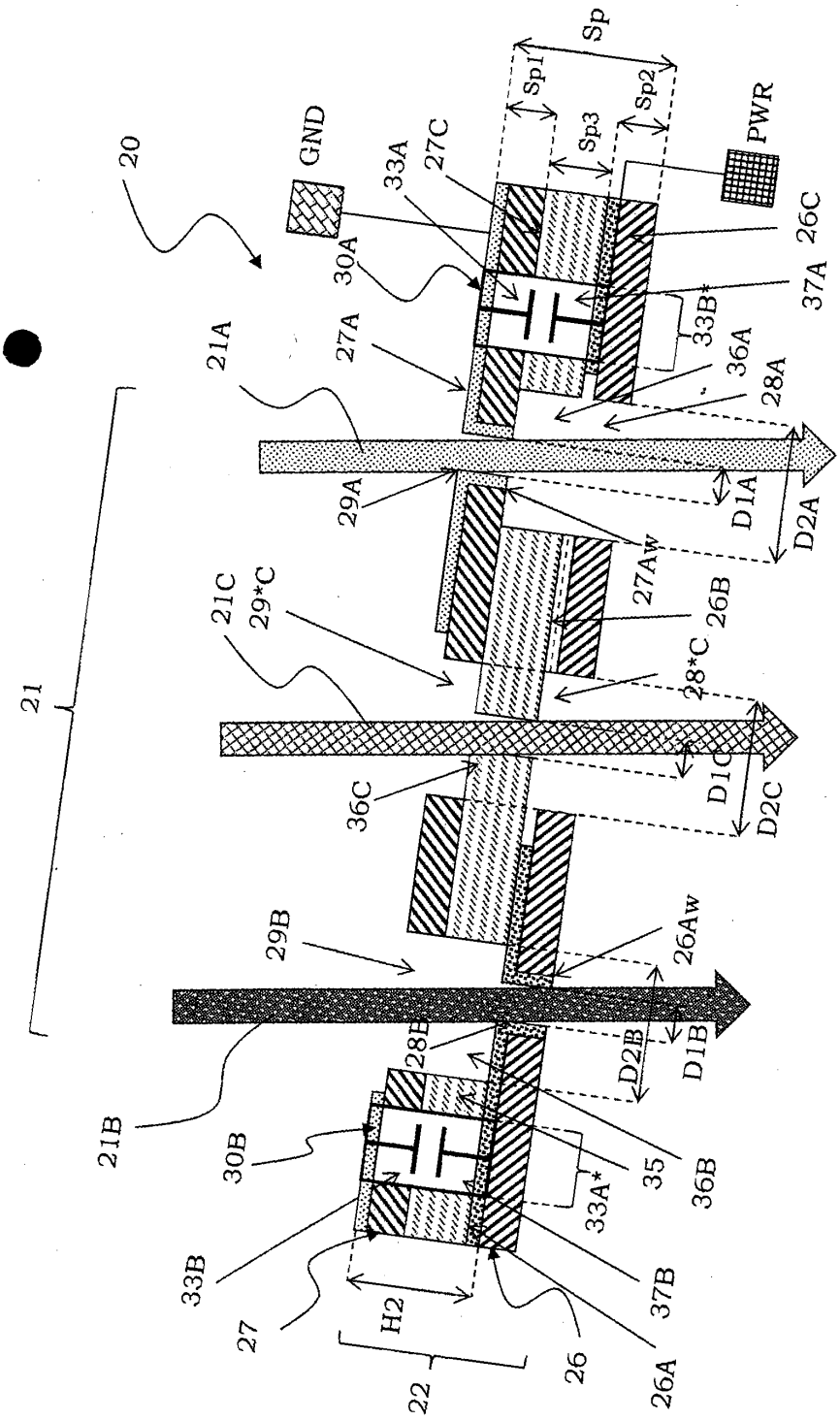


FIG. 6C

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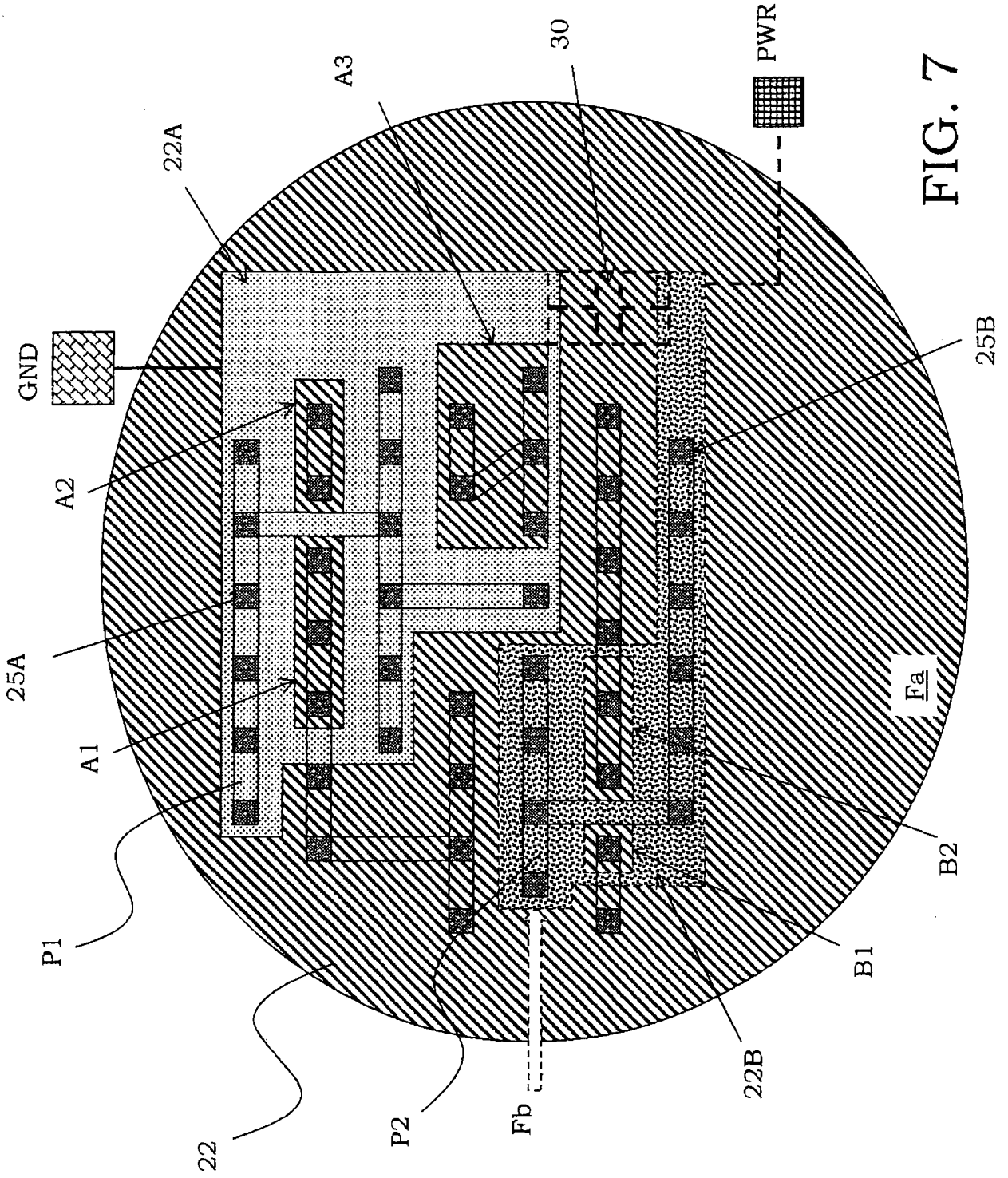


FIG. 7

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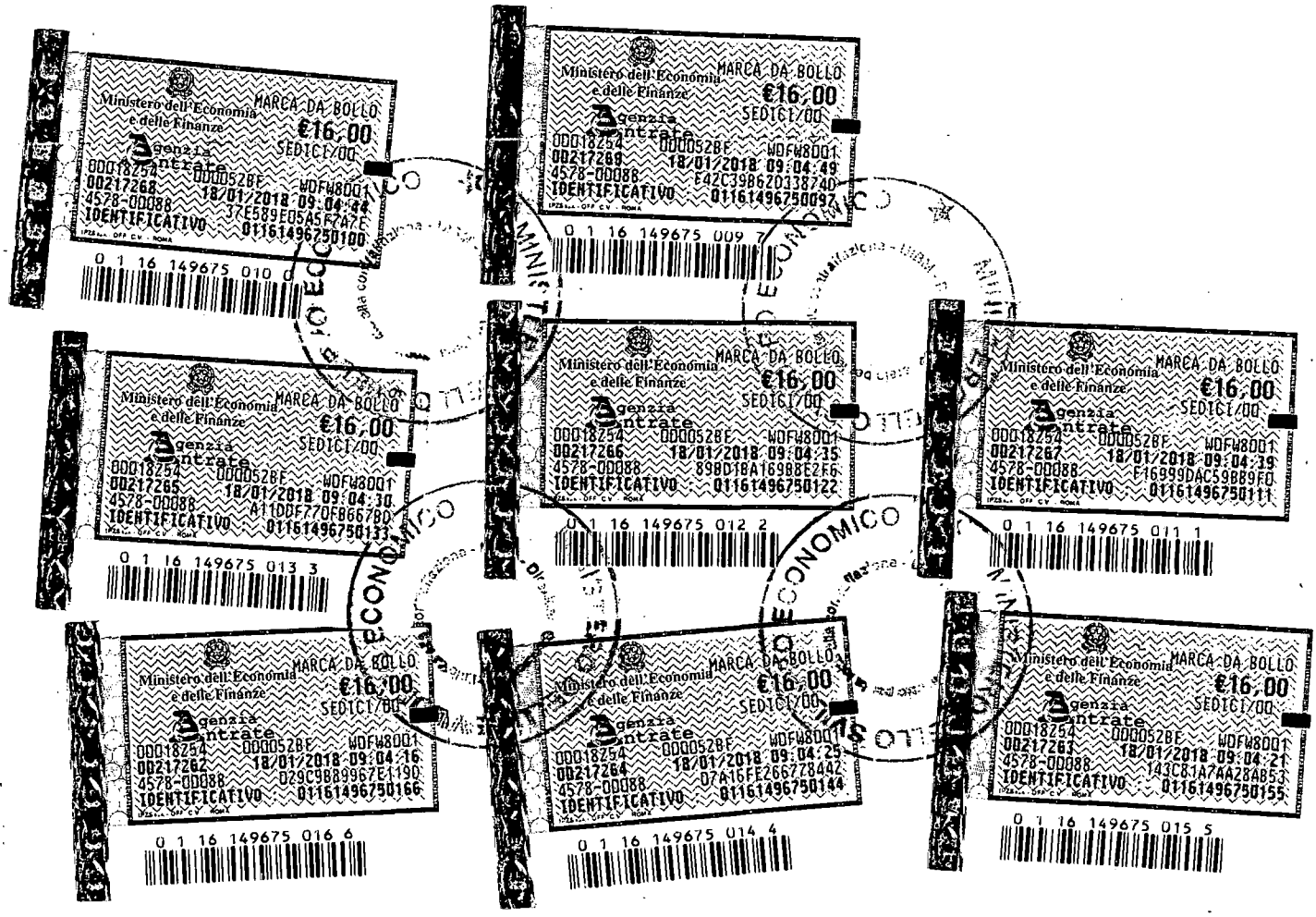
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ROMA li 18 GEN. 2018

IL FUNZIONARIO

Dr.ssa Cristina Papadia

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MINISTERO DELLO SVILUPPO ECONOMICO
Direzione Generale per la Lotta alla Contraffazione
Ufficio Italiano Brevetti e Marchi

Attestato di deposito

di

Invenzione industriale

Numero di domanda: 102017000021389

Data di deposito: 24/02/2017

Ministero dello Sviluppo Economico

Ricevuta di presentazione

per

Brevetto per invenzione industriale

Domanda numero: 102017000021389

Data di presentazione: 24/02/2017

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Carattere domanda	Ordinaria
Esenzione	NO
Accessibilità al pubblico	NO
Numero rivendicazioni	22
Autorità depositaria	

RICHIEDENTE/I

Natura giuridica	Persona giuridica
Denominazione	TECHNOPROBE S.p.A.
Partita IVA	02272540135
Nazione sede legale	Italia
Tipo Società	societa' per azioni

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Comune	Milano
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Fax	02 - 6703250
Indirizzo Email \ PEC	uibm-bef@pec.it
Riferimento depositante	TEC076BIT2

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Cognome	Nome

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Ferrari	Barbara

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MAGGIONI	Flavio	Italia

CLASSIFICAZIONI

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NUMERO DOMANDE COLLEGATE

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Tipo documento	Riserva	Documento
Rivendicazioni	NO	TEC076BIT2-rivendicazioni.pdf.p7m hash: 5ae6abe0d025afb02036043f23e1cf6b
Lettera di Incarico	NO	TEC076BIT2-lettera d'incarico.pdf.p7m hash: ca1a5aa95309c6844bad5eb4d02c3cee
Disegni	NO	TEC076BIT2-figure.pdf.p7m hash: fe6ca977d14475e8011c6fb63667080c
Descrizione in italiano*	NO	TEC076BIT2-Descrizione.pdf.p7m hash: 15d4344c96508fb51d6df341e37fcce0
Riassunto	NO	TEC076BIT2-Riassunto.pdf.p7m hash: bef2d8350b4a408fa845c2486671a063
Rivendicazioni in inglese	SI	hash:

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PAGAMENTI

Tipo	Identificativo	Data
Bollo	01160289571023	31/01/2017

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Domanda di brevetto per invenzione industriale dal titolo: "**Testa di misura con migliorate proprietà in frequenza**"

a nome: **TECHNOPROBE S.p.A.**

con sede in: **Cernusco Lombardone (LC)**

* * * * *

RIASSUNTO

Una testa di misura (20), atta a verificare la funzionalità di un dispositivo da testare integrato su un wafer semiconduttore, comprende almeno una guida (40, 41, 42) dotata di una pluralità di fori guida (40h, 41h, 42h) atti ad alloggiare una pluralità di elementi di contatto (21', 21", 21'"), ciascuno di tali elementi di contatto (21', 21", 21'") comprendendo un corpo (21pr, 21pp) che si estende tra una prima porzione di estremità (24) ed una seconda porzione di estremità (25). Opportunamente, l'almeno una guida (40, 41, 42) della testa di misura (20) comprende almeno una porzione conduttiva (30', 30", 30'") che include e mette in collegamento elettrico almeno un gruppo (40', 40", 40'"; 41', 41", 41'"; 42', 42", 42'") dei fori guida (40h, 41h, 42h) ed è atta a contattare un corrispondente gruppo degli elementi di contatto (21', 21", 21'"), tali elementi di contatto (21', 21", 21'") di tale corrispondente gruppo essendo atti al trasporto di uno stesso tipo di segnale.

(Figura 2A)

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DESCRIZIONE

Campo di applicazione

La presente invenzione fa riferimento ad una testa di misura per il test di dispositivi elettronici integrati su un substrato semiconduttore. Più specificatamente, la presente invenzione fa riferimento ad una testa di misura comprendente almeno una guida dotata di una pluralità di fori guida atti ad alloggiare una pluralità di elementi di contatto e la descrizione che segue è fatta con riferimento a questo campo di applicazione con il solo scopo di semplificarne l'esposizione.

Arte nota

Come è ben noto, una testa di misura [probe head] è un dispositivo elettronico atto a mettere in collegamento elettrico una pluralità di piazzole di contatto di una microstruttura, quale un dispositivo integrato su un wafer semiconduttore, con corrispondenti canali di una macchina di misura che ne esegue la verifica di funzionalità, in particolare elettrica, o genericamente il test.

Il test effettuato su dispositivi integrati serve in particolare a rilevare ed isolare dispositivi difettosi già in fase di produzione. Normalmente, le teste di misura vengono quindi utilizzate per il test elettrico dei dispositivi integrati su wafer prima del taglio e del montaggio degli stessi all'interno di un package di contenimento.

Generalmente, una testa di misura comprende una pluralità di elementi di contatto o sonde di contatto trattenute da almeno una guida o da almeno una coppia di guide (o supporti) sostanzialmente

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piastriformi e parallele tra loro. Tali guide sono dotate di appositi fori guida e sono poste ad una certa distanza fra loro in modo da lasciare una zona libera o zona d'aria per il movimento e l'eventuale deformazione delle sonde di contatto, le quali sono alloggiate in modo scorrevole in tali fori guida. La coppia di guide comprende in particolare una guida superiore ed una guida inferiore, entrambe provviste di fori guida entro cui scorrono assialmente le sonde di contatto, normalmente formate da fili di leghe speciali con buone proprietà elettriche e meccaniche.

Il buon collegamento fra le sonde di contatto e le piazzole di contatto del dispositivo da testare è assicurato dalla pressione della testa di misura sul dispositivo stesso, le sonde di contatto subendo, in occasione di tale contatto premente, una flessione all'interno della zona d'aria tra le guide ed uno scorrimento all'interno dei relativi fori guida. Teste di misura di questo tipo sono comunemente denominate "a sonde verticali" ed indicate con il termine anglosassone "vertical probe head".

In sostanza, le teste di misura a sonde verticali presentano una zona d'aria in cui avviene una flessione delle sonde di contatto, tale flessione potendo essere aiutata tramite un'opportuna configurazione delle sonde stesse o delle loro guide, come illustrato schematicamente in figura 1.

In particolare, nella figura 1 è schematicamente illustrata una testa di misura 1 comprendente almeno una guida superiore 2, usualmente indicata come "upper die", ed una guida inferiore 3, usualmente indicata come "lower die", separate da una zona d'aria 13,

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aventi rispettivi fori guida 4 e 5 entro i quali scorre una pluralità di sonde di contatto 6, solo una sonda della pluralità di sonde di contatto essendo mostrata per semplicità in figura 1.

Ciascuna sonda di contatto 6 termina ad un'estremità con una punta di contatto 7 destinata ad andare in battuta su una piazzola di contatto 8 di un dispositivo da testare integrato su un wafer 9, così da realizzare il contatto meccanico ed elettrico fra tale dispositivo da testare ed una apparecchiatura di test (non rappresentata) di cui tale testa di misura forma un elemento terminale.

Con il termine "punta di contatto" si indica qui e nel seguito una zona o regione di estremità di una sonda di contatto destinata al contatto con una piazzola di contatto del dispositivo da testare, tale zona o regione di estremità essendo non necessariamente appuntita.

In alcuni casi le sonde di contatto sono vincolate alla testa di misura in corrispondenza del supporto piastriforme superiore in maniera fissa: si parla di teste di misura "a sonde bloccate".

Più frequentemente però si utilizzano teste di misura con sonde non vincolate in maniera fissa, ma tenute interfacciate ad una cosiddetta board, eventualmente mediante una microcontattiera dotata di una pluralità di piazzole di contatto: si parla di teste di misura "a sonde non bloccate". La microcontattiera è chiamata usualmente "space transformer" dal momento che, oltre al contatto con le sonde, consente anche di ridistribuire spazialmente le piazzole di contatto su di essa realizzate rispetto alle piazzole di contatto presenti sul dispositivo da testare, in particolare con un allentamento dei vincoli di distanza tra i

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centri delle piazzole stesse.

In questo caso, come illustrato in figura 1, ogni sonda di contatto 6 presenta una ulteriore zona o regione di estremità che termina con una cosiddetta testa di contatto 10 verso una piazzola di contatto 11 di una pluralità di piazzole di contatto di uno space transformer 12. Il buon contatto elettrico tra sonde 6 e space transformer 12 viene assicurato mediante la battuta in pressione delle teste di contatto 10 delle sonde di contatto 6 sulle piazzole di contatto 11 dello space transformer 12 in maniera analoga al contatto tra le punte di contatto 7 con le piazzole di contatto 8 del dispositivo da testare integrato sul wafer 9.

Sono noti nel settore anche elementi di contatto nella forma di pogo pin, i quali comprendono essenzialmente un corpo elastico collegato a due porzioni di estremità, tale corpo elastico comprimendosi in occasione del contatto delle porzioni di estremità con le piazzole di contatto del dispositivo da testare e dello space transformer.

Generalmente, all'interno di una testa di misura, gli elementi di contatto sono suddivisi in elementi di contatto destinati a trasportare segnali di alimentazione e di massa verso il dispositivo da testare, e in elementi di contatto destinati a trasportare segnali operativi, in particolare segnali di ingresso/uscita, tra l'apparecchiatura di test e il dispositivo da testare.

In una testa di misura del tipo sopra descritto, è noto che la presenza di numerosi elementi di contatto destinati al trasporto di segnali di massa, così come la presenza di elementi di contatto destinati

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al trasporto di segnali di alimentazione, crea interferenze, causando quindi una rumorosità nei segnali di ingresso/uscita utilizzati per la verifica del dispositivo da testare, il che limita le prestazioni in frequenza della testa di misura. Nel caso di elementi di contatto destinati al trasporto di segnali di massa, possono inoltre sorgere svantaggiosi loop di massa.

È altresì nota la necessità di mettere in cortocircuito due o più piazzole di contatto del dispositivo da testare. Secondo una soluzione nota, conosciuta nel settore con il nome di look-back, è possibile mettere in cortocircuito due piazzole di contatto del dispositivo da testare tramite le sonde di contatto della testa di misura, in cui una prima sonda trasporta un segnale da una prima piazzola del dispositivo da testare verso l'apparecchiatura di test e da questa il segnale viene richiuso su una seconda piazzola del dispositivo da testare tramite una seconda sonda di contatto che contatta tale seconda piazzola. In questo caso, tuttavia, la distanza percorsa dal segnale dal dispositivo da testare fino all'apparecchiatura di test e viceversa causa una riduzione delle prestazioni in frequenza della testa di misura.

È quindi ben sentita nel settore l'esigenza di migliorare le prestazioni in frequenza di una testa di misura.

Il problema tecnico della presente invenzione è quindi quello di escogitare una testa di misura per il test di dispositivi elettronici, avente caratteristiche funzionali e strutturali tali da consentire di superare le limitazioni e gli inconvenienti che tuttora affliggono le teste di misura realizzate secondo l'arte nota, in particolare in grado di

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ridurre, se non eliminare, in maniera semplice le interferenze e quindi il rumore dovuto alla presenza degli elementi di contatto di massa e di alimentazione, nonché di permettere il collegamento elettrico tra piazzole di contatto di un dispositivo da testare senza ridurre le prestazioni in frequenza della testa di misura stessa.

Sommario dell'invenzione

L'idea di soluzione che sta alla base della presente invenzione è quella di realizzare una testa di misura in cui almeno una guida è dotata di fori guida per l'alloggiamento di elementi di contatto destinati al trasporto di segnali operativi, ovvero segnali di ingresso/uscita tra un'apparecchiatura di test e un dispositivo da testare, nonché di elementi di contatto destinati al trasporto di segnali di massa e di alimentazione, almeno un gruppo dei fori guida in cui sono alloggiati tali elementi di contatto di massa e/o almeno un gruppo dei fori guida in cui sono alloggiati tali elementi di contatto di alimentazione e/o almeno un gruppo dei fori guida in cui sono alloggiati tali elementi di contatto di ingresso/uscita essendo messi in collegamento elettrico da una porzione conduttiva realizzata in tale guida, tale porzione conduttiva formando un piano conduttivo comune.

Sulla base di tale idea di soluzione, il suddetto problema tecnico è risolto da una testa di misura atta a verificare la funzionalità di un dispositivo da testare integrato su un wafer semiconduttore, la testa di misura comprendendo almeno una guida dotata di una pluralità di fori guida atti ad alloggiare una pluralità di elementi di contatto, ciascuno di tali elementi di contatto comprendendo un corpo

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che si estende tra una prima porzione di estremità ed una seconda porzione di estremità, tale testa di misura essendo caratterizzata dal fatto che tale almeno una guida comprende almeno una porzione conduttiva che include e mette in collegamento elettrico almeno un gruppo dei fori guida ed è atta a contattare un corrispondente gruppo degli elementi di contatto, tali elementi di contatto di tale corrispondente gruppo essendo atti al trasporto di uno stesso tipo di segnale.

Più in particolare, l'invenzione comprende le seguenti caratteristiche supplementari e facoltative, prese singolarmente o all'occorrenza in combinazione.

Secondo un aspetto della presente invenzione, la testa di misura può comprendere almeno una prima porzione conduttiva e almeno una seconda porzione conduttiva, la prima porzione conduttiva includendo e mettendo in collegamento elettrico un primo gruppo di fori guida che alloggia primi elementi di contatto, la seconda porzione conduttiva includendo e mettendo in collegamento elettrico un secondo gruppo di fori guida che alloggia secondi elementi di contatto.

In particolare, i primi elementi di contatto alloggiati nel primo gruppo dei fori guida possono essere atti al trasporto di segnali di massa, e i secondi elementi di contatto alloggiati nel secondo gruppo dei fori guida possono essere atti al trasporto di segnali di alimentazione.

Ancora più in particolare, una tra la prima e la seconda porzione conduttiva può essere realizzata su una faccia dell'almeno una guida e l'altra porzione conduttiva può essere realizzata su una faccia

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opposta di tale almeno una guida.

Secondo un aspetto della presente invenzione, l'almeno una porzione conduttiva può essere separata da ulteriori porzioni conduttive e/o può essere localmente interrotta tramite almeno una zona non conduttiva in modo da non permettere il collegamento elettrico tra elementi di contatto destinati al trasporto di segnali differenti e/o elementi di contatto che non devono essere cortocircuitati.

A tal proposito, si sottolinea che l'almeno una guida può comprendere almeno una porzione dielettrica di rivestimento che ricopre tale almeno una zona non conduttiva.

Ulteriormente, la testa di misura dell'invenzione può comprendere almeno una guida inferiore, almeno una guida intermedia, e almeno una guida superiore, la guida inferiore e la guida intermedia essendo separate tra loro da una prima zona d'aria e la guida intermedia e la guida superiore essendo separate tra loro da una seconda zona d'aria, ciascuna delle guide comprendendo rispettivi fori guida per l'alloggiamento degli elementi di contatto, e dal fatto che una tra la prima e la seconda porzione conduttiva è realizzata su una faccia della guida inferiore e l'altra porzione conduttiva è realizzata su una faccia della guida intermedia.

Alternativamente, la testa di misura dell'invenzione può comprendere almeno una guida inferiore, almeno una guida intermedia, e almeno una guida superiore, la guida inferiore e la guida intermedia essendo separate tra loro da una prima zona d'aria e la guida intermedia e la guida superiore essendo separate tra loro da una

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seconda zona d'aria, ciascuna delle guide comprendendo rispettivi fori guida per l'alloggiamento degli elementi di contatto, e dal fatto che sia la guida inferiore sia la guida intermedia comprendono sia la prima porzione conduttiva sia la seconda porzione conduttiva, tali porzioni conduttive essendo tra loro separate fisicamente ed elettricamente da una zona non conduttiva delle guide.

Nello specifico, anche in questo caso, i primi elementi di contatto alloggiati nel primo gruppo dei fori guida possono essere atti al trasporto di segnali di massa, e i secondi elementi di contatto alloggiati nel secondo gruppo dei fori guida possono essere atti al trasporto di segnali di alimentazione.

Ulteriormente, la testa di misura dell'invenzione può comprendere almeno una terza porzione conduttiva che include e mette in collegamento elettrico un terzo gruppo dei fori guida che alloggia terzi elementi di contatto. In particolare, i terzi elementi di contatto alloggiati nel terzo gruppo dei fori guida possono essere atti al trasporto di segnali operativi di ingresso/uscita tra il dispositivo da testare e l'apparecchiatura di test.

Secondo un aspetto della presente invenzione, l'almeno una porzione conduttiva può rivestire almeno una porzione di una superficie interna di ogni foro guida di tale gruppo di fori guida.

Secondo un altro aspetto della presente invenzione, gli elementi di contatto possono essere nella forma di sonde di contatto in cui il corpo presenta una deformazione.

Alternativamente, gli elementi di contatto possono essere nella

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forma di pogo pin, il loro corpo comprendendo un involucro e un elemento elastico disposto nell'involucro, il quale definisce una prima superficie ed una seconda superficie, almeno una esse essendo atta ad andare in battuta sull'almeno una guida, il collegamento elettrico tra gli elementi di contatto e l'almeno una porzione conduttiva essendo un contatto premente tramite tale prima e/o seconda superficie.

Secondo un aspetto della presente invenzione, l'almeno una guida può comprendere almeno un pad comune collegato all'almeno una porzione conduttiva mediante una pista conduttiva.

Secondo un altro aspetto della presente invenzione, l'almeno una porzione conduttiva può essere disposta su una faccia dell'almeno una guida e può avere un'area inferiore ad un'area della faccia di tale almeno una guida.

Alternativamente, l'almeno una porzione conduttiva può ricoprire una faccia dell'almeno una guida, mettendo in collegamento elettrico tale almeno un gruppo dei fori guida, ad eccezione di aree in cui sono realizzati fori guida che non appartengono a tale almeno un gruppo.

Secondo un altro aspetto della presente invenzione, l'almeno una guida può comprendere almeno un'ulteriore porzione conduttiva, la quale include uno dei fori guida destinato ad alloggiare un singolo elemento di contatto, tale almeno una guida comprendendo un ulteriore pad comune collegato a tale almeno una ulteriore porzione conduttiva mediante un'ulteriore pista conduttiva e/o comprendendo una pista conduttiva che collega tale almeno una ulteriore porzione conduttiva ad

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altre porzioni conduttive.

Vi è inoltre da notare che l'almeno una porzione conduttiva può essere annegata nell'almeno una guida.

Secondo un altro aspetto della presente invenzione, l'almeno una porzione conduttiva può comprendere una pluralità di porzioni conduttive sovrapposte e isolate elettricamente fra loro.

Secondo un altro aspetto ancora della presente invenzione, la testa di misura può comprendere almeno una pista conduttiva che collega elettricamente almeno due porzioni conduttive che includono e mettono in collegamento elettrico due relativi gruppi dei fori guida e sono atte a contattare corrispondenti gruppi degli elementi di contatto, tali elementi di contatto inclusi in tali relativi gruppi essendo atti al trasporto di uno stesso tipo di segnale.

Infine, la testa di misura dell'invenzione può comprendere ulteriormente almeno un componente elettronico, preferibilmente un condensatore di filtraggio, collegato elettricamente ad almeno tale almeno una porzione conduttiva di tale almeno una guida.

Le caratteristiche e i vantaggi della testa di misura secondo l'invenzione risulteranno dalla descrizione, fatta qui di seguito, di un suo esempio di realizzazione dato a titolo indicativo e non limitativo con riferimento ai disegni allegati.

Breve descrizione dei disegni

In tali disegni:

- la figura 1 mostra schematicamente una testa di misura realizzata secondo l'arte nota;

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- le figure 2A-2C mostrano schematicamente una testa di misura realizzata secondo differenti forme di realizzazione della presente invenzione;

- le figure 3A-3C mostrano schematicamente una vista dall'alto di una guida della testa di misura delle figure 2A-2C, rispettivamente, mentre la figura 3D mostra schematicamente una vista dall'alto di una guida di una testa di misura secondo una variante di realizzazione alternativa della presente invenzione;

- le figure 4A e 4B mostrano schematicamente una testa di misura secondo ulteriori varianti di realizzazione della presente invenzione;

- le figure 5A e 5B mostrano schematicamente una porzione di una testa di misura secondo ulteriori varianti di realizzazione della presente invenzione;

- la figura 6 mostra schematicamente una porzione di una testa di misura secondo ancora un'ulteriore variante di realizzazione della presente invenzione;

- la figura 7 mostra schematicamente una testa di misura realizzata secondo una forma di realizzazione alternativa della presente invenzione, in cui elementi di contatto sono nella forma di pogo pin;

- le figure 8A-8C mostrano schematicamente viste dall'alto di una guida di una testa di misura secondo ulteriori varianti di realizzazione della presente invenzione;

- le figure 9A e 9B mostrano schematicamente viste dall'alto di una guida di una testa di misura secondo ulteriori varianti di

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realizzazione della presente invenzione; e

- le figure 10A e 10B mostrano schematicamente viste dall'alto di una guida di una testa di misura secondo ancora ulteriori varianti di realizzazione della presente invenzione.

Descrizione dettagliata

Con riferimento a tali figure, ed in particolare alla figura 2A, con 20 è globalmente e schematicamente indicata una testa di misura per il test di dispositivi elettronici integrati su un wafer semiconduttore realizzata secondo la presente invenzione.

È opportuno notare che le figure rappresentano viste schematiche e non sono disegnate in scala, ma sono invece disegnate in modo da enfatizzare le caratteristiche importanti dell'invenzione. Ulteriormente, nelle figure, i diversi pezzi sono rappresentati in modo schematico, la loro forma potendo variare a seconda dell'applicazione desiderata. È inoltre opportuno notare che nelle figure numeri di riferimento identici si riferiscono ad elementi identici per forma o funzione. Infine, particolari accorgimenti descritti in relazione a una forma di realizzazione illustrata in una figura sono utilizzabili anche per le altre forme di realizzazione illustrate nelle altre figure.

Come illustrato in figura 2A, la testa di misura 20 comprende almeno una guida 40, nell'esempio della figura una guida inferiore, dotata di una pluralità di fori guida 40h atti ad alloggiare una pluralità di elementi di contatto. Nello specifico, i fori guida 40h sono atti ad alloggiare una pluralità di primi elementi di contatto 21', destinati al trasporto di un primo tipo di segnale, una pluralità di secondi elementi

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di contatto 21", destinati al trasporto di un secondo tipo di segnale, nonché una pluralità di terzi elementi di contatto 21'", destinati al trasporto di un terzo tipo di segnale, come verrà specificato più dettagliatamente nel seguito.

La guida 40 è realizzata in un materiale non conduttivo, ad esempio in un materiale ceramico quale nitruro di silicio, oppure in un materiale vetroso o a base silicio, oppure in materiale poliammidico, oppure in qualunque altro materiale dielettrico adatto.

Generalmente, la testa di misura 20 è utilizzata per verificare la funzionalità di un dispositivo da testare che comprende almeno una prima regione destinata a ricevere segnali di alimentazione e di massa, ed una seconda regione destinata a ricevere/inviare segnali di ingresso/uscita da/verso un'apparecchiatura di test (non illustrata) collegata a tale testa di misura 20. Nella prima regione sono trattati segnali di alimentazione con elevati valori di corrente, di solito dell'ordine di 1 A o superiori, nonché segnali di massa, mentre nella seconda regione sono trattati segnali operativi ovvero segnali di ingresso/uscita con valori di corrente inferiori, di solito dell'ordine di 0,5 A o inferiori. Per questo motivo, nella testa di misura 20, sono presenti elementi di contatto destinati al trasporto dei segnali di alimentazione e di massa ed elementi di contatto destinati al trasporto dei segnali di ingresso/uscita verso/da un dispositivo da testare, distinti tra loro e con diverse caratteristiche fisiche e meccaniche.

A tal proposito, si sottolinea che nella presente descrizione con il termine "primi elementi di contatto" si identificano tutti gli elementi di

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contatto destinati al trasporto delle masse (riferimento numerico 21'), con il termine "secondi elementi di contatto" si identificano tutti gli elementi di contatto destinati al trasporto delle alimentazioni (riferimento numerico 21"), mentre con il termine "terzi elementi di contatto" si identificano tutti gli elementi di contatto destinati al trasporto dei segnali operativi, ovvero i segnali di ingresso/uscita tra l'apparecchiatura di test ed il dispositivo da testare (riferimento numerico 21'"), senza che tale distinzione sia intesa in senso limitativo.

Ad esempio, nel caso di elementi di contatto nella forma di sonde formate da fili metallici, al fine di realizzare i primi e secondi elementi di contatto 21' e 21" è possibile utilizzare fili di diverso diametro, ad esempio di diametro maggiore, rispetto al diametro dei fili che realizzano i terzi elementi di contatto 21'"; è possibile utilizzare anche diversi materiali per questi diversi elementi di contatto.

Nell'esempio di figura 2A sono mostrati sei elementi di contatto, in particolare due primi elementi di contatto 21', due secondi elementi di contatto 21" e due terzi elementi di contatto 21'", ma il numero di tali elementi di contatto può ovviamente variare a seconda delle esigenze e/o delle circostanze, le figure essendo fornite solo a titolo indicativo e non limitativo della presente invenzione.

Ulteriormente, sempre a titolo di esempio non limitativo dell'invenzione, la figura 2A mostra una testa di misura 20 in cui gli elementi di contatto sono nella forma di sonde di contatto, preferibilmente formate da fili metallici, aventi un corpo 21pr che presenta una predeformazione ed è atto a deformarsi ulteriormente in

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occasione del contatto premente con piazzole di contatto di un dispositivo da testare, tali sonde di contatto essendo alloggiate nei fori guida 40h, i quali sono realizzati nell'unica guida 40, ma l'invenzione non è limitata a questo, la testa di misura 20 potendo comprendere sia una guida inferiore sia una guida intermedia sia una guida superiore, così come un diverso tipo di elementi di contatto, come sarà illustrato dettagliatamente nel seguito.

Ciascun elemento di contatto della testa di misura 20 comprende quindi il corpo 21pr, il quale si estende lungo un asse longitudinale H-H tra una prima porzione di estremità o punta di contatto 24 e una seconda porzione di estremità o testa di contatto 25.

Più in particolare, la punta di contatto 24 è atta ad andare in battuta su corrispondenti piazzole o pad di contatto 26 di un dispositivo da testare integrato su un wafer semiconduttore 27.

Ulteriormente, nell'esempio illustrato, la testa di misura 20 è del tipo a sonde non vincolate e gli elementi di contatto terminano con la testa di contatto 25 che è atta ad andare in battuta su corrispondenti piazzole o pad di contatto 28 di un interposer o space transformer 29.

In particolare, lo space transformer 29 è atto a realizzare una trasformazione spaziale delle distanze tra i centri o pitch delle piazzole di contatto realizzate su sue opposte facce, tale space transformer 29 essendo generalmente collegato ad una scheda a circuito stampato o PCB (non illustrata), la quale a sua volta si interfaccia con l'apparecchiatura di test (anch'essa non illustrata).

Vantaggiosamente secondo la presente invenzione, la guida 40

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comprende almeno una prima porzione conduttiva 30' che include un primo gruppo 40' dei fori guida 40h. In altre parole, la prima porzione conduttiva 30' ricopre un'area della guida 40 che include il primo gruppo 40' dei fori 40h, i quali sono quindi realizzati in corrispondenza di tale area.

Nello specifico, i fori guida del primo gruppo 40' sono messi in collegamento elettrico tra loro dalla prima porzione conduttiva 30' e alloggiano un corrispondente gruppo di elementi di contatto, in particolare un gruppo dei primi elementi di contatto 21', e quindi alloggiano elementi di contatto atti al trasporto di segnali di massa verso il dispositivo da testare. In questo modo, la prima porzione conduttiva 30' realizza un piano conduttivo comune, in particolare un piano di massa, per i primi elementi di contatto 21' alloggiati nei fori guida del primo gruppo 40', tali primi elementi di contatto 21' essendo quindi collegati elettricamente tra loro tramite tale piano di massa, con il quale sono tutti in contatto.

In altre parole, nella testa di misura 20, i primi elementi di contatto 21' cortocircuitati tra loro e alloggiati nel primo gruppo 40' dei fori guida 40h sono atti al trasporto di uno stesso segnale di massa, con conseguente eliminazione delle interferenze sui segnali operativi e miglioramento delle prestazioni in frequenza della testa di contatto 20 nel suo complesso.

Come illustrato nella figura 2A, la prima porzione conduttiva 30' è disposta su una porzione superficiale della guida 40, in particolare su una sua faccia FA, tale faccia FA essendo una faccia superiore

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secondo il riferimento locale della figura 2. La prima porzione conduttiva 30' può anche essere disposta su una faccia FB, opposta alla faccia FA, della guida 40, tale faccia FB essendo una faccia inferiore secondo il riferimento locale della figura 2A, oppure può essere disposta su entrambe le facce FA e FB.

Nella forma di realizzazione della figura 2A, come precedentemente descritto, i primi elementi di contatto 21' della testa di misura 20 sono sonde di contatto aventi il corpo 21pr dotato di una predeformazione ed atto a deformarsi ulteriormente durante il contatto con le piazzole di contatto 26 e 28 del dispositivo da testare e dello space transformer 29, rispettivamente. In questo caso, la prima porzione conduttiva 30' preferibilmente riveste anche almeno una porzione 40'W di una superficie interna di ogni foro guida del primo gruppo 40' dei fori guida 40h. Ancora più preferibilmente, la superficie interna dei fori guida del primo gruppo 40' è interamente rivestita dalla prima porzione conduttiva 30', tale porzione 40'W coincidendo quindi con l'intera superficie interna dei fori. Il collegamento elettrico tra le prime sonde di contatto 21' e la prima porzione conduttiva 30' è quindi realizzato tramite un contatto strisciante tra il corpo 21pr delle sonde e la porzione 40'W metallizzata dei fori guida in cui le sonde sono alloggiate.

Si sottolinea tuttavia che, anche nel caso in cui la prima porzione conduttiva 30' non riveste la superficie dei fori guida, il contatto strisciante è comunque garantito dallo spessore della prima porzione conduttiva 30' stessa.

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In una forma di realizzazione non mostrata nelle figure, è anche possibile realizzare la prima porzione conduttiva 30' in modo che essa sia annegata nella guida 40, realizzando in questo modo un piano di massa che collega elettricamente i fori guida del primo gruppo 40' all'interno della guida 40. Ovviamente, una tale prima porzione conduttiva 30' dovrà affiorare in corrispondenza della superficie interna dei fori guida per contattare elettricamente le prime sonde di contatto 21'.

La presenza della prima porzione conduttiva 30', la quale consente di collegare elettricamente almeno un gruppo dei primi elementi di contatto 21', destinati al trasporto di segnali di massa realizzando così un piano conduttivo (di massa) comune, permette di abbattere il rumore nei segnali operativi trasportati dai terzi elementi di contatto 21''' all'interno della testa di misura 20.

In tal modo, la prima porzione conduttiva 30', mettendo in collegamento elettrico il primo gruppo 40' dei fori guida 40h, cortocircuita almeno un corrispondente gruppo dei primi elementi di contatto 21', tale gruppo essendo in particolare un gruppo di elementi di contatto di massa.

Al fine di ridurre ulteriormente il rumore, è preferibile che anche i secondi elementi di contatto 21", destinati al trasporto di segnali di alimentazione, siano tra loro collegati elettricamente e di conseguenza, in una forma di realizzazione rappresentata in figura 2B, la guida 40 comprende almeno una seconda porzione conduttiva 30" che include e mette in collegamento elettrico un secondo gruppo 40" dei

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fori guida 40h in cui è alloggiato un corrispondente gruppo di tali secondi elementi di contatto 21", tale seconda porzione conduttiva 30" essendo fisicamente separata dalla prima porzione conduttiva 30' e quindi non collegata elettricamente ad essa. In questo caso, i secondi elementi di contatto 21" collegati dalla seconda porzione conduttiva 30", ovvero alloggiati nel secondo gruppo 40" dei fori guida 40h, sono atti al trasporto di segnali di alimentazione e tale seconda porzione conduttiva 30" realizza anch'essa un piano conduttivo comune, in particolare un piano di alimentazione.

In tal modo, nella testa di misura 20, i secondi elementi di contatto 21" alloggiati nel secondo gruppo 40" dei fori guida 40h sono cortocircuitati tra loro ed atti al trasporto di un medesimo segnale di alimentazione.

Come illustrato per la prima porzione conduttiva 30', anche la seconda porzione conduttiva 30" è disposta su una porzione superficiale della guida 40, ovvero è disposta sulla faccia FA e/o sulla faccia FB della guida 40. Ulteriormente, anche la seconda porzione conduttiva 30" riveste almeno una porzione 40"W di una superficie interna di ogni foro guida del secondo gruppo 40" dei fori guida 40h (preferibilmente tutta la superficie), il collegamento elettrico tra i secondi elementi di contatto 21" e tale seconda porzione conduttiva 30" essendo sempre garantito dal contatto strisciante tra il corpo 21pr di tali secondi elementi di contatto 21" e tale porzione 40"W rivestita di materiale conduttivo, in particolare metallizzata.

È opportuno rimarcare nuovamente che, nella sua forma più

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generale, la testa di misura 20 comprende elementi di contatto destinati al trasporto di segnali di massa ed alimentazione, così come elementi di contatto destinati al trasporto di segnali operativi che sono alloggiati nelle guide in qualsivoglia combinazione, le porzioni conduttive essendo opportunamente sagomate in modo da cortocircuitare anche fori guida non adiacenti.

In una forma di realizzazione della presente invenzione illustrata in figura 2C, la guida 40 comprende ulteriormente almeno una terza porzione conduttiva 30''' che include e mette in collegamento elettrico un terzo gruppo 40''' dei fori guida 40h in cui è alloggiato un corrispondente gruppo dei terzi elementi di contatto 21''', tale terza porzione conduttiva 30''' essendo fisicamente separata dalla prima porzione conduttiva 30' e della seconda porzione conduttiva 30'' e quindi non collegata elettricamente alle stesse. In questo caso, i terzi elementi di contatto 21''' collegati dalla terza porzione conduttiva 30''', ovvero alloggiati nel terzo gruppo 40''' dei fori guida 40h, sono atti al trasporto di segnali operativi, ovvero segnali di ingresso/uscita tra il dispositivo da testare e l'apparecchiatura di test e tale terza porzione conduttiva 30''' realizza anch'essa un piano conduttivo comune, in particolare un piano di segnale.

In tal modo, nella testa di misura 20, i terzi elementi di contatto 21''' alloggiati nel terzo gruppo 40''' dei fori guida 40h sono cortocircuitati tra loro ed atti al trasporto di un medesimo segnale operativo, ovvero di un medesimo segnale di ingresso/uscita tra il dispositivo da testare e l'apparecchiatura di test.

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La forma di realizzazione della figura 2C è particolarmente vantaggiosa nel caso in cui vi sia la necessità di cortocircuitare due o più piazzole di contatto del dispositivo da testare, in quanto è possibile realizzare una configurazione di tipo look-back accorciando notevolmente il percorso dei segnali, che non percorrono tutti gli elementi di contatto da e verso l'apparecchiatura di testa ma si fermano al piano conduttivo comune di segnale, con conseguenti vantaggi in termini di prestazioni in frequenza della testa di misura 20.

Come illustrato per la prima porzione conduttiva 30' e la seconda porzione conduttiva 30", anche la terza porzione conduttiva 30"' è disposta su una porzione superficiale della guida 40, ovvero è disposta sulla faccia FA e/o sulla faccia FB della guida 40. Ulteriormente, anche la terza porzione conduttiva 30"' riveste almeno una porzione 40"'W di una superficie interna di ogni foro guida del terzo gruppo 40"' dei fori guida 40h (preferibilmente tutta la superficie), il collegamento elettrico tra i terzi elementi di contatto 21"' e tale terza porzione conduttiva 30"' essendo sempre garantito dal contatto strisciante tra il corpo 21pr di tali terzi elementi di contatto 21"' e tale porzione 40"'W rivestita di materiale conduttivo, in particolare metallizzata.

Le porzioni conduttive 30', 30" e 30"' sono realizzate in un materiale metallico scelto ad esempio tra rame (Cu), argento (Ag), oro (Au), palladio (Pd), rodio (Rh) e loro leghe.

Ovviamente, anche se non illustrato nelle figure, è possibile prevedere una configurazione in cui è presente solamente la prima

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porzione conduttiva 30', una configurazione in cui è presente solamente la seconda porzione conduttiva 30", o una configurazione in cui è presente solamente la terza porzione conduttiva 30"', oppure una combinazione delle stesse.

La figura 3A mostra una vista dall'alto della guida 40, in particolare della sua faccia FA, in cui la prima porzione conduttiva 30' mette in collegamento elettrico il primo gruppo 40' dei fori guida 40h, atti ad alloggiare un corrispondente gruppo dei primi elementi di contatto 21' che trasportano segnali di massa, mentre la figura 3B mostra una vista dall'alto della guida 40, sempre della sua faccia FA, in cui, oltre alla prima porzione conduttiva 30', viene realizzata anche la seconda porzione conduttiva 30", la quale mette in collegamento elettrico il secondo gruppo 40" dei fori guida 40h, atti ad alloggiare un corrispondente gruppo dei secondi elementi di contatto 21" che trasportano segnali di alimentazione, ed è separata fisicamente ed elettricamente dalla prima porzione conduttiva 30' da una zona non conduttiva 31 della guida 40. Allo stesso modo, la figura 3C mostra una vista dall'alto della guida 40, sempre della sua faccia FA, in cui, oltre alla prima porzione conduttiva 30' e alla seconda porzione conduttiva 30", viene realizzata anche la terza porzione conduttiva 30"', la quale mette in collegamento elettrico il terzo gruppo 40"' dei fori guida 40h, atti ad alloggiare un corrispondente gruppo dei terzi elementi di contatto 21"' che trasportano segnali di ingesso/uscita, ed è separata fisicamente ed elettricamente dalle porzioni conduttive 30' e 30" sempre dalla zona non conduttiva 31 della guida 40.

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Si sottolinea che sia la prima porzione conduttiva 30' sia la seconda porzione conduttiva 30" sia la terza porzione conduttiva 30"' rivestono solamente una porzione superficiale della guida 40, in particolare solo una porzione della sua faccia FA e/o della sua faccia FB, ovvero la prima, la seconda e la terza porzione conduttiva 30', 30" e 30"' non si estendono per tutta l'area di tale faccia FA e/o FB, così da evitare di mettere in cortocircuito anche elementi di contatto non destinati ad essere cortocircuitati. In altre parole, le porzioni conduttive 30', 30" e 30"' hanno un'area inferiore ad un'area della faccia della guida sulla quale sono realizzate.

La guida 40 non è quindi rivestita interamente dalle porzioni conduttive 30', 30" e 30"', ed è sempre presente almeno la zona non conduttiva 31 che separa tali porzioni conduttive, in tale zona non conduttiva 31 essendo realizzati i fori guida che alloggiano gli elementi di contatto non destinati ad essere cortocircuitati.

Alternativamente, in un'ulteriore forma di realizzazione della presente invenzione illustrata in figura 3D, la prima porzione conduttiva 30' ricopre una faccia della guida 40 (nell'esempio la faccia FA), ad eccezione di aree in cui sono realizzati i fori guida destinati ad alloggiare elementi di contatto che non devono essere cortocircuitati. In altre parole, la prima porzione conduttiva 30' non è realizzata in aree in cui sono realizzati i fori guida che non appartengono al gruppo 40'. In questo caso, la zona non conduttiva 31 è quindi realizzata solamente in corrispondenza di tali secondi fori guida che non appartengono a tale primo gruppo 40'. Si sottolinea che, in questo caso, la zona non

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conduttiva 31 può anche essere nella forma di una pluralità di zone non conduttive, ciascuna realizzata solamente in corrispondenza di un foro guida che si desidera isolare elettricamente. Lo stesso discorso può essere fatto anche per la seconda porzione conduttiva 30" e per la terza porzione conduttiva 30'".

A tal proposito, è inoltre possibile prevedere che la zona non conduttiva 31 sia a sua volta ricoperta da almeno una porzione aggiuntiva di materiale dielettrico o porzione dielettrica di rivestimento disposta sulla guida 40, in modo tale da evitare la presenza nella guida 40 di scanalature, ad esempio tra porzioni conduttive differenti o in corrispondenza di fori guida che non devono essere metallizzati, in cui possono depositarsi detriti metallici prodotti dal contatto strisciante degli elementi di contatto con le pareti dei fori guida. In altre parole, la porzione dielettrica di rivestimento, la quale ha preferibilmente uno spessore sostanzialmente identico a quello delle porzioni conduttive, ricopre le zone non conduttive 31 impedendo il depositarsi di detriti metallici, così da evitare leakage e collegamenti elettrici indesiderati tra elementi di contatto destinati al trasporto di un diverso tipo di segnale.

È altresì possibile considerare un caso in cui tutti gli elementi di contatto che trasportano analoghi segnali (ad esempio tutti gli elementi di contatto di ingresso/uscita o tutti gli elementi di massa o tutti gli elementi di alimentazione) sono collegati elettricamente tramite una delle porzioni conduttive 30', 30" e 30'", oppure un caso in cui solamente alcuni di essi sono collegati da una delle porzioni conduttive 30', 30" e 30'".

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Ulteriormente, secondo una variante di realizzazione illustrata in figura 4A, la testa di misura 20 comprende almeno una guida inferiore, indicata sempre con 40, almeno una guida intermedia 41, ed almeno una guida superiore 42. La guida inferiore 40 e la guida intermedia 41 sono separate tra loro da un'opportuna prima zona d'aria 32' mentre la guida intermedia 41 e la guida superiore 42 sono separate tra loro da un'opportuna seconda zona d'aria 32".

Si fa presente che è preferibile realizzare le porzioni conduttive 30', 30" e 30"' nella guida inferiore 40 e/o nella guida intermedia 41 della testa di misura 20, in quanto in questo modo tali porzioni conduttive 30', 30" e 30"' risultano maggiormente vicine al dispositivo da testare.

Nella forma di realizzazione della figura 4A, la guida intermedia 41 è dotata di una pluralità di fori guida 41h, atti ad alloggiare gli elementi di contatto 21', 21" e 21"'.

Allo stesso modo, la guida superiore 42 è dotata di una pluralità di fori guida 42h, atti ad alloggiare gli elementi di contatto 21', 21" e 21"'.

Opportunamente, anche la guida intermedia 41 può comprendere la prima porzione conduttiva 30', la quale include e mette in collegamento elettrico un primo gruppo 41' dei fori guida 41h, tale primo gruppo 41' alloggiando un corrispondente gruppo dei primi elementi di contatto 21', i quali trasportano segnali di massa. Inoltre, la guida intermedia 41 può comprendere anche la seconda porzione conduttiva 30", la quale include e mette in collegamento elettrico un

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secondo gruppo 41" dei fori guida 41h, tale secondo gruppo 41" alloggiando un corrispondente gruppo dei secondi elementi di contatto 21", i quali trasportano segnali di alimentazione.

Allo stesso modo, anche la guida intermedia 41 può comprendere la terza porzione conduttiva 30"', la quale include e mette in collegamento elettrico un terzo gruppo 41"' dei fori guida 41h, tale terzo gruppo 41"' alloggiando un corrispondente gruppo di terzi elementi di contatto 21"', i quali trasportano segnali di ingrasso /uscita.

Nell'esempio della figura 4A, la quale è fornita solo a titolo indicativo e non limitativo della presente invenzione, la prima porzione conduttiva 30' è disposta su una porzione superficiale della guida intermedia 41, in particolare su una sua faccia FD, tale faccia FD essendo una faccia inferiore secondo il riferimento locale della figura 4A. La prima porzione conduttiva 30' può anche essere disposta su una faccia FC, opposta alla faccia FD, della guida intermedia 41, tale faccia FC essendo una faccia superiore secondo il riferimento locale della figura 4A, oppure può essere disposta su entrambe le facce FC e FD. Anche le porzioni conduttive 30" e 30"' possono essere realizzate analogamente.

Come già osservato per la guida inferiore 40, le porzioni conduttive 30', 30" e 30"' rivestono solamente una porzione superficiale anche della guida intermedia 41, in particolare solo una porzione della sua faccia FC e/o della sua faccia FD, cioè le porzioni conduttive 30', 30" e 30"' non si estendono su tutta l'area di tale faccia FC e/o FD e quindi non si estendono su tutta l'area della guida intermedia 41.

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Ulteriormente, nell'esempio di figura 4A, la testa di misura 20 è realizzata tramite la così detta tecnologia "a piastre shiftate", in cui gli elementi di contatto 21', 21" e 21'", sono nella forma di sonde di contatto chiamate "buckling beam" e inizialmente realizzate diritte, lo spostamento o shift relativo delle guide provocando una deformazione del corpo delle sonde, nonché il desiderato trattenimento delle sonde stesse grazie all'attrito con le pareti dei fori guida entro cui scorrono.

In questo caso, come osservato in precedenza per la guida inferiore 40, anche nella guida intermedia 41 la prima porzione conduttiva 30' riveste almeno una porzione 41'W di una superficie interna di ogni foro guida del primo gruppo 41' dei fori guida 41h, la seconda porzione conduttiva 30" riveste almeno una porzione 41"W di una superficie interna di ogni foro guida del secondo gruppo 41" dei fori guida 41h, e la terza porzione conduttiva 30'" riveste almeno una porzione 41'"W di una superficie interna di ogni foro guida del terzo gruppo 41'" dei fori guida 41h, il collegamento elettrico tra le sonde di contatto 21', 21" e 21'" e le porzioni conduttive 30', 30" e 30'" essendo realizzato tramite un contatto strisciante tra il corpo 21pr di tali sonde di contatto e tali porzioni 41'W, 41"W e 41'"W metallizzate, rispettivamente.

È possibile prevedere una configurazione in cui solo una tra la guida inferiore 40 e la guida intermedia 41 comprende la prima porzione conduttiva 30' e/o la seconda porzione conduttiva 30", oppure è anche possibile prevedere una configurazione in cui sia la guida inferiore 40 sia la guida intermedia 41 comprendono la prima porzione

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conduttiva 30' e/o la seconda porzione conduttiva 30".

In figura 4A è mostrata a titolo di esempio una forma di realizzazione in cui sia la guida inferiore 40 sia la guida intermedia 41 comprendono sia la prima porzione conduttiva 30' sia la seconda porzione conduttiva 30". Tale forma di realizzazione aumenta inoltre le possibilità di contatto strisciante tra le sonde di contatto e le porzioni conduttive 30' e 30" ed eventualmente le porzioni 41'W e 41"W metallizzate.

Sempre con riferimento alla figura 4A, è possibile prevedere una configurazione in cui sia la guida intermedia 41 sia la guida inferiore 40 comprendono la terza porzione conduttiva 30'". Alternativamente, è possibile prevedere una configurazione in cui solamente una tra la guida intermedia 41 e la guida inferiore 40 comprende la terza porzione conduttiva 30'" che mette in cortocircuito elementi di contatto di segnale di ingresso/uscita, preferibilmente la guida inferiore 40.

In una forma di realizzazione preferita, illustrata schematicamente in figura 4B, la prima porzione conduttiva 30' viene realizzata su una tra la guida inferiore 40 e la guida intermedia 41, in particolare la guida inferiore 40, e la seconda porzione conduttiva 30" viene realizzata sull'altra tra la guida inferiore 40 e la guida intermedia 41, in particolare la guida intermedia 41, nell'esempio illustrato su due loro facce disposte una di fronte all'altra, in particolare la faccia superiore FA della guida inferiore 40 e la faccia inferiore FD della guida intermedia 41, secondo il riferimento locale della figura 4B. Ovviamente

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anche in questa forma di realizzazione una tra le due guide 40 e 41, preferibilmente la guida inferiore 40, può comprendere la terza porzione conduttiva 30'''. Tale forma di realizzazione semplifica la realizzazione delle porzioni conduttive 30', 30", 30" distribuite su guide diverse.

Ovviamente, sia per la forma di realizzazione della figura 4A sia per la forma di realizzazione della figura 4B, è possibile prevedere che anche la guida superiore 42 comprenda la prima porzione conduttiva 30' e/o la seconda porzione conduttiva 30" e/o la terza porzione conduttiva 30''', così come è anche possibile prevedere una configurazione in cui non è presente la guida intermedia 41 ma è presente solo la guida superiore 42, sulla quale possono essere realizzate la prima porzione conduttiva 30' e/o la seconda porzione conduttiva 30" e/o la terza porzione conduttiva 30'''.

In una forma di realizzazione preferita della presente invenzione, illustrata nelle figure 5A e 5B, una stessa guida, in particolare la guida inferiore 40 come illustrato nelle figure, comprende la prima porzione conduttiva 30', la quale è realizzata sulla faccia FA, e comprende la seconda porzione conduttiva 30", la quale è realizzata sulla faccia opposta FB. Considerazioni analoghe si potrebbero fare per la guida intermedia 41 e le facce FC e FD su cui realizzare la prima e/o la seconda porzione conduttiva, 30' e 30", e anche per la guida superiore 42.

Si sottolinea che questa particolare forma di realizzazione, in cui la prima porzione conduttiva 30' e la seconda porzione conduttiva 30" sono realizzate su due facce opposte di una stessa guida, è

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particolarmente vantaggiosa poiché, come indicato schematicamente in figura 5B, in molti casi i primi elementi di contatto 21' destinati al trasporto di segnali di massa e i secondi elementi di contatto 21" destinati al trasporto di segnali di alimentazione si trovano molto vicini nella testa di misura 20, ad esempio alternati l'uno all'altro, e per questo motivo risulterebbe più complicato realizzare entrambe le porzioni conduttive 30' e 30" su una stessa faccia di una guida della testa di misura 20. In altre parole, in una tale forma di realizzazione, una tra la prima e la seconda porzione conduttiva 30' o 30" è atta a mettere in collegamento elettrico i primi elementi di contatto 21' destinati al trasporto dei segnali di massa mentre l'altra porzione conduttiva, realizzata su una faccia opposta della stessa guida, è atta a mettere in collegamento elettrico i secondi elementi di contatto 21" destinati al trasporto dei segnali di alimentazione, in particolare alternati ai primi elementi di contatto 21' destinati al trasposto dei segnali di massa, semplificando in questo modo la realizzazione della testa di misura 20 ed evitando complicati intrecci di porzioni conduttive. Nel caso in cui i primi elementi di contatto 21' destinati al trasporto di segnali di massa ed i secondi elementi di contatto 21" destinati al trasporto di segnali di alimentazione sono alternati l'un l'altro, entrambe le porzioni conduttive 30' e 30" sono localmente interrotte da opportune zone non conduttive 31' e 31" (analoghe a quanto osservato in relazione alle figure 3A-3D), rispettivamente, in modo da non mettere in collegamento elettrico elementi di contatto di massa con elementi di contatto di alimentazione. Le zone non

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conduttive 31' e 31" impediscono quindi localmente il collegamento elettrico tra elementi di contatto adiacenti destinati al trasporto di segnali differenti.

Ovviamente, sebbene non illustrato nelle figure 5A e 5B, anche in questa forma di realizzazione è possibile prevedere la presenza, su una delle due facce della guida, o anche su entrambe le facce, della terza porzione conduttiva 30'", anch'essa eventualmente interrotta da opportune zone non conduttive nel caso in cui i terzi elementi di contatto 21'" si trovino molto vicini, ad esempio alternati, ai primi elementi di contatto 21' e/o ai secondi elementi di contatto 21".

Secondo un'ulteriore forma di realizzazione alternativa della presente invenzione illustrata in figura 6, è possibile prevedere che una o più tra le porzioni conduttive 30', 30" e 30'" (la seconda porzione conduttiva 30" in figura 6) comprenda una pluralità di porzioni conduttive sovrapposte e isolate elettricamente fra loro, tali porzioni conduttive essendo identificate con il riferimento numerico 30"1-30"n in figura 6. In questo caso, un primo strato 30"1 è realizzato sulla faccia FA della guida 40 e gli strati successivi sono realizzati a partire da tale primo strato 30"1, strati conduttivi consecutivi essendo separati tra loro da uno strato non conduttivo 38". In questo modo, strati conduttivi differenti possono realizzare piani conduttivi comuni per domini di alimentazione (o di massa o di segnale) differenti, qualora l'applicazione lo richieda.

A titolo di esempio, nel caso in cui la testa di misura 20 debba trasportare una pluralità di segnali di alimentazione differenti, indicati

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come Vcc1 e Vcc2, in questa forma di realizzazione la faccia FA guida 40 comprende un corrispondente numero di strati 30"1-30"n della seconda porzione conduttiva 30", ciascuno strato essendo atto a mettere in collegamento elettrico i relativi secondi elementi di contatto 21" destinati al trasporto di un singolo specifico segnale di alimentazione. Ulteriormente, l'altra faccia della guida, nell'esempio la faccia FB, può essere ricoperta dalla prima porzione conduttiva 30', la quale mette in collegamento elettrico gli elementi di contatto 21' destinati al trasporto delle masse. Anche in questo caso, ciascuno strato conduttivo può essere quindi localmente interrotto da opportune zone non conduttive 31" in modo da non mettere in collegamento elettrico elementi di contatto che non devono essere cortocircuitati tra loro. In particolare, le zone non conduttive 31" di uno strato sono realizzate in corrispondenza dei fori che alloggiano elementi di contatto che non devono essere cortocircuitati da tale strato, mentre tale strato ricopre almeno parzialmente le pareti dei fori guida che alloggiano elementi di contatto che devono essere cortocircuitate da esso.

È opportuno rimarcare che le porzioni conduttive 30', 30" e 30"' possono quindi essere più di una, in quanto possono esserci più domini di alimentazione, di massa e di segnale (in questo ultimo caso quando differenti gruppi di piazzole del dispositivo da testare devono essere cortocircuitati), ed eventualmente possono essere disposte su differenti livelli se le circostanze lo richiedono.

Come precedentemente osservato, nelle figure 2A-2C, 4A-4B, 5A-5B e 6, gli elementi di contatto 21', 21" e 21"' sono nella forma di

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sonde di contatto del tipo "buckling beam".

In un'ulteriore forma di realizzazione alternativa della presente invenzione, rappresentata in figura 7, gli elementi di contatto della testa di misura 20 sono nella forma di pogo pin. In questa forma di realizzazione, la testa di misura 20 comprende la guida inferiore 40 e la guida superiore 42 e non comprende la guida intermedia 41.

In particolare, ciascun elemento di contatto 21', 21" e 21"' comprende un corpo 21pp che include a sua volta un involucro 33 ed un elemento elastico 34 disposto all'interno di tale involucro 33. Una prima estremità dell'elemento elastico 34 è collegata ad una prima porzione di estremità o punta di contatto 24 del pogo pin mentre una seconda estremità di tale elemento elastico 34, opposta alla prima estremità, è collegata ad una seconda porzione di estremità o testa di contatto 25 del pogo pin. La punta di contatto 24, la quale è inserita in fori guida 40h realizzati nella guida inferiore 40, è atta ad andare in battuta su piazzole di contatto 26 di un dispositivo da testare integrato su un wafer 27, mentre la testa di contatto 25, la quale è inserita in fori guida 42h realizzati nella guida superiore 42, è atta ad andare in battuta su piazzole di contatto 28 di uno space transformer 29, la guida inferiore 40 e la guida superiore 42 essendo separate da una zona d'aria 35.

L'involucro 33 di ciascun pogo pin ha forma preferibilmente cilindrica, ma ovviamente anche altre forme sono possibili.

Opportunamente, la guida inferiore 40 e/o la guida superiore 42 comprende la prima porzione conduttiva 30', la quale include e

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mette in collegamento elettrico un primo gruppo 40' dei fori guida 40h realizzati nella guida inferiore 40 e/o un primo gruppo 42' dei fori guida 42h realizzati nella guida superiore 42. Ovviamente, la guida inferiore 40 e/o la guida superiore 42 possono comprendere anche la seconda porzione conduttiva 30", la quale include e mette in collegamento elettrico un secondo gruppo 40" dei fori guida 40h realizzati nella guida inferiore 40 e/o un secondo gruppo 42" dei fori guida 42h realizzati nella guida superiore 42. La guida inferiore 40 e/o la guida superiore 42 possono anche comprendere la terza porzione conduttiva 30"', la quale include e mette in collegamento elettrico un terzo gruppo 40"' dei fori guida 40h realizzati nella guida inferiore 40 e/o un terzo gruppo 42"' dei fori guida 42h realizzati nella guida superiore 42, tale terza porzione conduttiva 30"' essendo preferibilmente realizzata sulla guida inferiore 40.

I fori guida del primo gruppo 40' e/o del primo gruppo 42' alloggiano primi elementi di contatto o pogo pin 21' destinati al trasporto di segnali di massa, i fori guida del secondo gruppo 40" e/o del secondo gruppo 42" alloggiano secondi elementi di contatto o pogo pin 21" destinati al trasporto di segnali di alimentazione, mentre i fori guida del terzo gruppo 40"' e/o del terzo gruppo 42"' alloggiano terzi elementi di contatto o pogo pin 21"' destinati al trasporto di segnali di ingresso/uscita tra il dispositivo da testare e l'apparecchiatura di test.

L'involucro 33 del corpo 21pp di ciascun pogo pin è conformato in modo tale da definire una prima superficie S1 ed una seconda superficie S2, disposte ad estremità opposte di tale involucro

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33 lungo un suo asse longitudinale H-H, le quali sono in grado di andare in battuta sulla guida inferiore 40 e sulla guida superiore 42, rispettivamente, l'involucro 33 di tali pogo pin avendo dimensione trasversale massima (generalmente attorno ad 80 μm) maggiore di un diametro di tali fori guida, con il termine diametro intendendosi una dimensione trasversale massima dei fori guida, anche di sezione non circolare.

La punta di contatto 24 e la testa di contatto 25 sono elettricamente collegate all'involucro 33 dei pogo pin, tale involucro 33 essendo realizzato in un materiale conduttivo.

In questo modo, il contatto premente tra l'involucro 33, in particolare tra le sue superfici S1 e S2, e la prima porzione conduttiva 30' assicura il collegamento elettrico tra i primi pogo pin 21' alloggiati nel primo gruppo di fori guida 40' e 42' della guida inferiore 40 e superiore 42, rispettivamente, tali pogo pin essendo destinati al trasporto di segnali di massa, mentre il contatto premente tra l'involucro 33, in particolare tra le sue superfici S1 e S2, e la seconda porzione conduttiva 30" assicura il collegamento elettrico tra i secondi pogo pin 21" alloggiati nel secondo gruppo di fori guida 40" e 42" della guida inferiore 40 e superiore 42, rispettivamente, tali pogo pin essendo destinati al trasporto di segnali di alimentazione. Allo stesso modo, il contatto premente tra l'involucro 33, in particolare tra le sue superfici S1 e S2, e la terza porzione conduttiva 30'" assicura il collegamento elettrico tra i terzi pogo pin 21'" alloggiati nel terzo gruppo di fori guida 40'" e 42'" della guida inferiore 40 e superiore 42, rispettivamente, tali

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pogo pin essendo destinati al trasporto di segnali operativi di ingresso/uscita.

In altre parole, il collegamento elettrico tra i pogo pin 21', 21" e 21"' e le porzioni conduttive 30', 30" e 30"', rispettivamente, è realizzato in questo caso tramite un contatto premente della prima superficie S1 e della seconda superficie S2 dell'involucro 33 sulla guida inferiore 40 e sulla guida superiore 42, rispettivamente, tali porzioni conduttive essendo realizzate su una porzione superficiale della guida inferiore 40, in particolare su una sua faccia FA, tale faccia FA essendo una faccia superiore secondo il riferimento locale della figura 7 e/o su una faccia FE della guida superiore 42, tale faccia FE essendo una faccia inferiore, sempre secondo il riferimento locale della figura 7.

L'utilizzo dei pogo pin in qualità di elementi di contatto è particolarmente vantaggioso in quanto in questo caso non è più necessario garantire un contatto strisciante tra i gli elementi di contatto e la superficie interna dei fori guida, un contatto premente tra l'involucro 33, in particolare tra le sue superfici S1 e S2, e le guide essendo sufficiente ad assicurare il corretto collegamento elettrico tra le porzioni conduttive e i tali elementi di contatto, opportuni gruppi dei quali sono in questo modo tra loro collegati elettricamente (cortocircuitati).

Secondo un'ulteriore forma di realizzazione della presente invenzione, rappresentata nella figura 8A, la guida inferiore 40, che comprende la prima porzione conduttiva 30', comprende almeno un primo pad comune 36' collegato a tale prima porzione conduttiva 30'

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mediante una prima pista [track] conduttiva 37'. In questo modo, i primi elementi di contatto 21' destinati al trasporto di segnali di massa sono connessi a tale primo pad comune 36' tramite la prima pista conduttiva 37', tale primo pad comune 36' essendo quindi un pad comune di massa. Sebbene la figura 8A mostri solamente la guida inferiore 40, anche la guida intermedia 41 e/o la guida superiore 42 possono comprendere un primo pad comune ed una relativa prima pista conduttiva.

Il pad comune 36' può essere collegato tramite un primo filo di collegamento ad un involucro [housing] (non illustrati) della testa di misura 20.

Ulteriormente, come illustrato in figura 8B, la guida inferiore 40 e/o la guida intermedia 41 e/o la guida superiore 42 (la guida inferiore 40 nella figura) possono comprendere almeno un secondo pad comune 36" collegato alla seconda porzione conduttiva 30" mediante una seconda pista [track] conduttiva 37". In questo modo, i secondi elementi di contatto 21" destinati al trasporto di segnali di alimentazione sono connessi al secondo pad comune 36" tramite la seconda pista conduttiva 37", tale secondo pad comune 36" essendo quindi un pad comune di alimentazione.

Come illustrato in figura 8C, la guida inferiore 40 e/o la guida intermedia 41 e/o la guida superiore 42 (la guida inferiore 40 nella figura) possono anche comprendere almeno un terzo pad comune 36'" collegato alla terza porzione conduttiva 30'" mediante una terza pista [track] conduttiva 37'". In questo modo, i terzi elementi di contatto 21'"

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destinati al trasporto di segnali operativi di ingresso/uscita sono connessi al terzo pad comune 36''' tramite la terza pista conduttiva 37''', tale terzo pad comune 36''' essendo quindi un pad comune di segnale.

La presenza di un pad comune 36', 36'', 36''' collegato alla rispettiva porzione conduttiva 30', 30'', 30''' consente di estrarre un rispettivo segnale dalla testa di misura 20 e collegarlo, ad esempio, ad una scheda PCB collegata a tale testa di misura 20. È possibile quindi prevedere che tale pad comune trasporti un segnale di monitoraggio, ad esempio dei livelli di tensione sulla corrispondente guida.

Come illustrato in figura 9A, è anche possibile prevedere su una guida anche la presenza di una ulteriore porzione conduttiva 30bis in aggiunta alle porzioni conduttive 30', 30'' e 30''', tale ulteriore porzione conduttiva 30bis includendo e metallizzando un singolo foro guida 40h, preferibilmente destinato ad alloggiare un terzo elemento di contatto 21''' che trasporta segnali di ingresso/uscita. In questo caso la guida comprende anche un ulteriore pad comune 36bis collegato alla ulteriore porzione conduttiva 30bis mediante una ulteriore pista conduttiva 37bis. In questo modo, il terzo elemento di contatto 21''' alloggiato in tale foro metallizzato è connesso elettricamente all'ulteriore pad comune 36bis tramite l'ulteriore pista conduttiva 37bis, così che è possibile trasportare un segnale di ingresso/uscita a partire dall'ulteriore pad comune 36bis verso ad esempio una scheda PCB. Si può anche prevedere la presenza di una pluralità di ulteriori porzioni conduttive, separate tra loro, ciascuna realizzando la metallizzazione di un rispettivo singolo foro guida 40h, eventualmente collegate tra loro

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tramite piste conduttive o tramite componenti circuitali se le circostanze lo richiedono.

Ulteriormente, in accordo con una forma di realizzazione alternativa della presente invenzione illustrata in figura 9B, è possibile prevedere che almeno due porzioni conduttive (due prime porzioni conduttive 30' nella figura 9B, ma non limitatamente a queste) della guida 40 siano collegate elettricamente tra loro tramite una pista conduttiva 39 della guida, così da poter collegare elettricamente tra loro gruppi di elementi di contatto destinati al trasporto di uno stesso tipo di segnale ma che sono alloggiati in rispettivi gruppi di fori guida fra loro distanziati nella guida (due gruppi 40' nella figura 9B ma non limitatamente a questi).

Infine, in accordo con la forma di realizzazione illustrata nelle figure 10A e 10B, la guida 40, che comprende almeno una porzione conduttiva (la porzione conduttiva 30' nelle figure ma non limitatamente a questa), comprende anche almeno un componente circuitale 50 collegato a tale porzione conduttiva, la quale realizza un piano conduttivo comune.

In particolare, nell'esempio della figura 10A, la guida 40 comprende almeno due porzioni conduttive (due prime porzioni conduttive 30' nella figura ma non limitatamente a queste), il componente elettronico 50 essendo elettricamente collegato ad esse. A titolo di esempio, il componente circuitale 50 è un condensatore di filtraggio, sempre indicato con il riferimento numerico 50, avente i reofori 50r connessi a rispettive porzioni conduttive. Si sottolinea che

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tale condensatore 50 può mettere in collegamento tra loro porzioni conduttive destinate a cortocircuitare elementi di contatto destinati al trasporto di segnali di massa, di alimentazione o di segnali di ingresso/uscita. Opportunamente, una tale forma di realizzazione consente di massimizzare l'effetto di filtraggio dei condensatori 50, e quindi di ridurre al minimo le interferenze causate dagli elementi di contatto che trasportano i segnali di massa e di alimentazione, nonché di ottimizzare la tecnica del loop-back, dato che tali condensatori di filtraggio 50 sono così posizionati il più possibile vicino alle punte di contatto degli elementi di contatto (vale a dire sulla guida inferiore 40), ovvero in prossimità del wafer 27.

Alternativamente, come illustrato in figura 10B, è anche possibile prevedere una configurazione in cui il condensatore 50 ha un primo reoforo 50r1 collegato ad una porzione conduttiva che include una pluralità di fori guida (la porzione conduttiva 30' nella figura ma non limitatamente a questa) e l'altro reoforo 50r2 connesso ad una porzione conduttiva che include e metallizza un singolo foro guida.

Si sottolinea che il componente circuitale 50, il quale come osservato è preferibilmente un condensatore di filtraggio, può anche essere un qualunque altro componente adatto ad esigenze specifiche, come ad esempio un induttore o un resistore od anche un relé, eventualmente alloggiato in opportune sedi di alloggiamento realizzate nella guida. Ad esempio è possibile considerare di collegare una coppia di induttori in corrispondenza di due porzioni conduttive (come le due prime porzioni conduttive 30' nella figura ma non limitatamente a

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queste) destinate ad essere cortocircuitate in una configurazione di loopback e monitorare così il segnale in corrispondenza delle stesse.

In conclusione, la presente invenzione prevede la realizzazione di una testa di misura in cui almeno una guida comprende almeno una porzione conduttiva che include e mette in collegamento elettrico fori guida atti ad alloggiare elementi di contatto che trasportano uno stesso tipo di segnale.

Vantaggiosamente secondo la presente invenzione, elementi di contatto che trasportano segnali di massa sono così messi in collegamento elettrico nella testa di misura, preferibilmente in corrispondenza della guida inferiore, cosa che permette di ridurre notevolmente, se non di eliminare del tutto, il rumore nel segnale generato dalle diverse masse, in quanto la porzione conduttiva della guida realizza un piano di massa comune a tutti gli elementi di contatto di massa.

Allo stesso modo, anche il collegamento elettrico tra gli elementi di contatto che trasportano le alimentazioni contribuisce a ridurre le interferenze e quindi il rumore nella testa di misura. In questo modo, tramite la presente invenzione, è possibile ridurre anche il rumore di modo comune.

Di conseguenza, la presente invenzione consente un miglioramento delle prestazioni in frequenza della testa di misura nel suo complesso.

Ulteriormente, anche il collegamento elettrico tra elementi di contatto che trasportano segnali operativi, ovvero segnali di

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ingresso/uscita, preferibilmente in corrispondenza della guida inferiore, consente un aumento delle prestazioni in frequenza della testa di misura nel caso in cui vi sia l'esigenza di mettere in collegamento elettrico due o più piazzole di contatto del dispositivo da testare.

Opportunamente, è possibile cortocircuitare tra loro gruppi di sonde (e quindi di corrispondenti pad del dispositivo), senza necessariamente trasportare il relativo segnale all'apparecchiatura di test, tale cortocircuito essendo vantaggiosamente realizzato in corrispondenza della guida inferiore e/o intermedia, ovvero in prossimità del dispositivo da testare, migliorando in tal modo le prestazioni elettriche del cortocircuito realizzato.

Vi è inoltre da dire che la possibilità di cortocircuitare gli elementi di contatto di massa e di alimentazione permette di migliorare le prestazioni in corrente della testa di misura della presente invenzione, evitando inoltre eventuali bruciature di tali elementi di contatto.

È anche possibile ottenere una testa di misura con migliorate prestazioni in termini di filtraggio dei segnali, grazie alla presenza di opportuni componenti circuitali, in particolare condensatori connessi elettricamente alla porzione conduttiva.

Infine, la presenza di un pad comune consente di poter accedere agli elementi di contatto direttamente dall'involucro della testa di misura, tale pad comune sostituendo quindi la pluralità di piazzole di contatto e permettendo ad esempio un monitoraggio dei relativi segnali.

Ovviamente un tecnico del ramo, allo scopo di soddisfare

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esigenze contingenti e specifiche, potrà apportare alla testa di misura sopra descritta numerose modifiche e varianti, tutte comprese nell'ambito di protezione dell'invenzione quale definito dalle seguenti rivendicazioni.

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RIVENDICAZIONI

1. Testa di misura (20) atta a verificare la funzionalità di un dispositivo da testare integrato su un wafer semiconduttore, detta testa di misura (20) comprendendo almeno una guida (40, 41, 42) dotata di una pluralità di fori guida (40h, 41h, 42h) atti ad alloggiare una pluralità di elementi di contatto (21', 21", 21'"), ciascuno di detti elementi di contatto (21', 21", 21'") comprendendo un corpo (21pr, 21pp) che si estende tra una prima porzione di estremità (24) ed una seconda porzione di estremità (25), detta testa di misura (20) essendo caratterizzata dal fatto che detta almeno una guida (40, 41, 42) comprende almeno una porzione conduttiva (30', 30", 30'") che include e mette in collegamento elettrico almeno un gruppo (40', 40", 40'"; 41', 41", 41"; 42', 42", 42'") di detti fori guida (40h, 41h, 42h) ed è atta a contattare un corrispondente gruppo di detti elementi di contatto (21', 21", 21'"), detti elementi di contatto (21', 21", 21'") di detto corrispondente gruppo essendo atti al trasporto di uno stesso tipo di segnale.

2. Testa di misura (20) secondo la rivendicazione 1, caratterizzata dal fatto di comprendere almeno una prima porzione conduttiva (30') e almeno una seconda porzione conduttiva (30"), detta prima porzione conduttiva (30') includendo e mettendo in collegamento elettrico un primo gruppo (40', 41', 42') di detti fori guida (40h, 41h, 42h) che alloggia primi elementi di contatto (21'), detta seconda porzione conduttiva (30") includendo e mettendo in collegamento elettrico un secondo gruppo (40", 41", 42") di detti fori guida (40h, 41h,

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42h) che alloggia secondi elementi di contatto (21").

3. Testa di misura (20) secondo la rivendicazione 2, caratterizzata dal fatto che detti primi elementi di contatto (21') alloggiati in detto primo gruppo (40', 41', 42') di detti fori guida (40h, 41h, 42h) sono atti al trasporto di segnali di massa, e detti secondi elementi di contatto (21") alloggiati in detto secondo gruppo (40", 41", 42") di detti fori guida (40h, 41h, 42h) sono atti al trasporto di segnali di alimentazione.

4. Testa di misura (20) secondo la rivendicazione 2 o 3, caratterizzata dal fatto che una tra detta prima e seconda porzione conduttiva (30', 30") è realizzata su una faccia (FA, FB; FC, FD) di detta almeno una guida (40, 41, 42) e l'altra tra detta prima e seconda porzione conduttiva (30", 30') è realizzata su una faccia opposta (FB, FA; FD, FC) di detta almeno una guida (40, 41, 42).

5. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detta almeno una porzione conduttiva (30', 30", 30"') è separata da ulteriori porzioni conduttive e/o è localmente interrotta tramite almeno una zona non conduttiva (31, 31, 31") in modo da non permettere il collegamento elettrico tra elementi di contatto destinati al trasporto di segnali differenti e/o elementi di contatto che non devono essere cortocircuitati.

6. Testa di misura (20) secondo la rivendicazione 5, caratterizzata dal fatto che detta almeno una guida (40, 41, 42) comprende almeno una porzione dielettrica di rivestimento che ricopre detta almeno una zona non conduttiva (31, 31, 31").

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7. Testa di misura (20) secondo la rivendicazione 2, caratterizzata dal fatto di comprendere almeno una guida inferiore (40), almeno una guida intermedia (41), e almeno una guida superiore (42), detta guida inferiore (40) e detta guida intermedia (41) essendo separate tra loro da una prima zona d'aria (32') e detta guida intermedia (41) e detta guida superiore (42) essendo separate tra loro da una seconda zona d'aria (32"), ciascuna di dette guide (40, 41, 42) comprendendo rispettivi fori guida (40h, 41h, 42h) per l'alloggiamento di detti elementi di contatto (21', 21", 21'"), e dal fatto che una tra detta prima e seconda porzione conduttiva (30', 30") è realizzata su una faccia (FA, FB) di detta guida inferiore (40) e l'altra tra detta prima e seconda porzione conduttiva (30", 30') è realizzata su una faccia (FC, FD) di detta guida intermedia (41).

8. Testa di misura (20) secondo la rivendicazione 2, caratterizzata dal fatto di comprendere almeno una guida inferiore (40), almeno una guida intermedia (41), e almeno una guida superiore (42), detta guida inferiore (40) e detta guida intermedia (41) essendo separate tra loro da una prima zona d'aria (32') e detta guida intermedia (41) e detta guida superiore (42) essendo separate tra loro da una seconda zona d'aria (32"), ciascuna di dette guide (40, 41, 42) comprendendo rispettivi fori guida (40h, 41h, 42h) per l'alloggiamento di detti elementi di contatto (21', 21", 21'"), e dal fatto che sia detta guida inferiore (40) sia detta guida intermedia (41) comprendono sia detta prima porzione conduttiva (30') sia detta seconda porzione conduttiva (30"), detta prima porzione conduttiva (30') e detta seconda porzione conduttiva (30")

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essendo tra loro separate fisicamente ed elettricamente da una zona non conduttiva (31, 31', 31") di dette guide (40, 41).

9. Testa di misura (20) secondo la rivendicazione 7 o 8, caratterizzata dal fatto che detti primi elementi di contatto (21') alloggiati in detto primo gruppo (40', 41', 42') di detti fori guida (40h, 41h, 42h) sono atti al trasporto di segnali di massa, e detti secondi elementi di contatto (21") alloggiati in detto secondo gruppo (40", 41", 42") di detti fori guida (40h, 41h. 42h) sono atti al trasporto di segnali di alimentazione.

10. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto di comprendere almeno una terza porzione conduttiva (30"') che include e mette in collegamento elettrico un terzo gruppo (40"', 41"', 42"') di detti fori guida (40h, 41h, 42h) che alloggia terzi elementi di contatto (21"').

11. Testa di misura (20) secondo la rivendicazione 10, caratterizzata dal fatto che detti terzi elementi di contatto (21"') alloggiati in detto terzo gruppo (40"', 41"', 42"') di detti fori guida (40h, 41h, 42h) sono atti al trasporto di segnali operativi di ingresso/uscita tra il dispositivo da testare e l'apparecchiatura di test.

12. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detta almeno una porzione conduttiva (30', 30", 30"') riveste almeno una porzione (40'W, 40"W, 40"'W; 41'W, 41"W, 41"'W) di una superficie interna di ogni foro guida di detto gruppo (40', 40", 40"'; 41', 41", 41"') di detti fori guida (40h, 41h).

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13. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detti elementi di contatto (21', 21", 21'") sono nella forma di sonde di contatto in cui detto corpo (21pr) presenta una deformazione.

14. Testa di misura (20) secondo una qualsiasi delle rivendicazioni da 1 a 6, caratterizzata dal fatto che detti elementi di contatto (21', 21", 21'") sono nella forma di pogo pin, detto corpo (21pp) comprendendo un involucro (33) e un elemento elastico (34) disposto in detto involucro (33), detto involucro (33) definendo una prima superficie (S1) ed una seconda superficie (S2), almeno una di dette superfici (S1, S2) essendo atta ad andare in battuta su detta almeno una guida (40, 42), il collegamento elettrico tra detti elementi di contatto (21', 21", 21'") e detta almeno una porzione conduttiva (30', 30", 30'") essendo un contatto premente tramite detta prima e/o seconda superficie (S1, S2).

15. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detta almeno una guida (40, 41, 42) comprende almeno un pad comune (36', 36", 36'") collegato a detta almeno una porzione conduttiva (30', 30", 30'") mediante una pista conduttiva (37', 37", 37'").

16. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detta almeno una porzione conduttiva (30', 30", 30'") è disposta su una faccia (FA, FB, FC, FD, FE) di detta almeno una guida (40, 41, 42) e ha un'area inferiore ad un'area di detta faccia (FA, FB, FC, FD, FE) di detta almeno una guida (40, 41, 42).

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17. Testa di misura (20) secondo una qualsiasi delle rivendicazioni da 1 a 15, caratterizzata dal fatto che detta almeno una porzione conduttiva (30', 30", 30"') ricopre una faccia di detta almeno una guida (40, 41, 42), mettendo in collegamento elettrico detto almeno un gruppo (40', 41', 42'; 40", 41", 42"; 40"', 41"', 42"') di detti fori guida (40h, 41h, 42h), ad eccezione di aree in cui sono realizzati fori guida che non appartengono a detto almeno un gruppo (40', 41', 42'; 40", 41", 42"; 40"', 41"', 42"').

18. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detta almeno una guida (40, 41, 42) comprende almeno una ulteriore porzione conduttiva (30bis), la quale include uno di detti fori guida (40h, 41h, 42h) destinato ad alloggiare un singolo elemento di contatto, detta almeno una guida (40, 41, 42) comprendendo un ulteriore pad comune (36bis) collegato a detta almeno una ulteriore porzione conduttiva (30bis) mediante una ulteriore pista conduttiva (37bis) e/o comprendendo una pista conduttiva che collega detta almeno una ulteriore porzione conduttiva (30bis) ad altre porzioni conduttive.

19. Testa di misura (20) secondo la rivendicazione 1, caratterizzata dal fatto che detta almeno una porzione conduttiva (30', 30", 30"') è annegata in detta almeno una guida (40, 41, 42).

20. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto che detta almeno una porzione conduttiva (30', 30", 30"') comprende una pluralità di porzioni conduttive sovrapposte e isolate elettricamente fra loro.

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21. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto di comprendere almeno una pista conduttiva (39) che collega elettricamente almeno due porzioni conduttive che includono e mettono in collegamento elettrico due relativi gruppi di detti fori guida (40h, 41h, 42h) e sono atte a contattare corrispondenti gruppi di detti elementi di contatto (21', 21", 21'"), detti elementi di contatto inclusi in detti relativi gruppi essendo atti al trasporto di uno stesso tipo di segnale.

22. Testa di misura (20) secondo una qualsiasi delle rivendicazioni precedenti, caratterizzata dal fatto di comprendere ulteriormente almeno un componente circuitale (50), preferibilmente un condensatore, collegato elettricamente ad almeno detta almeno una porzione conduttiva di detta almeno una guida (40, 41, 42).

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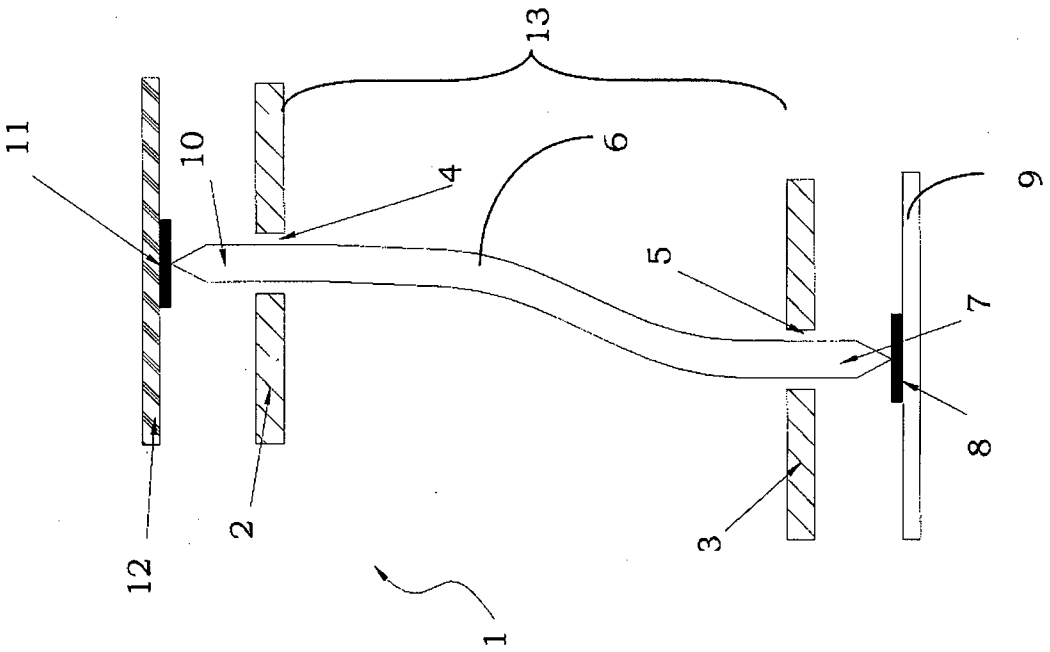


FIG. 1
ARTE NOTA

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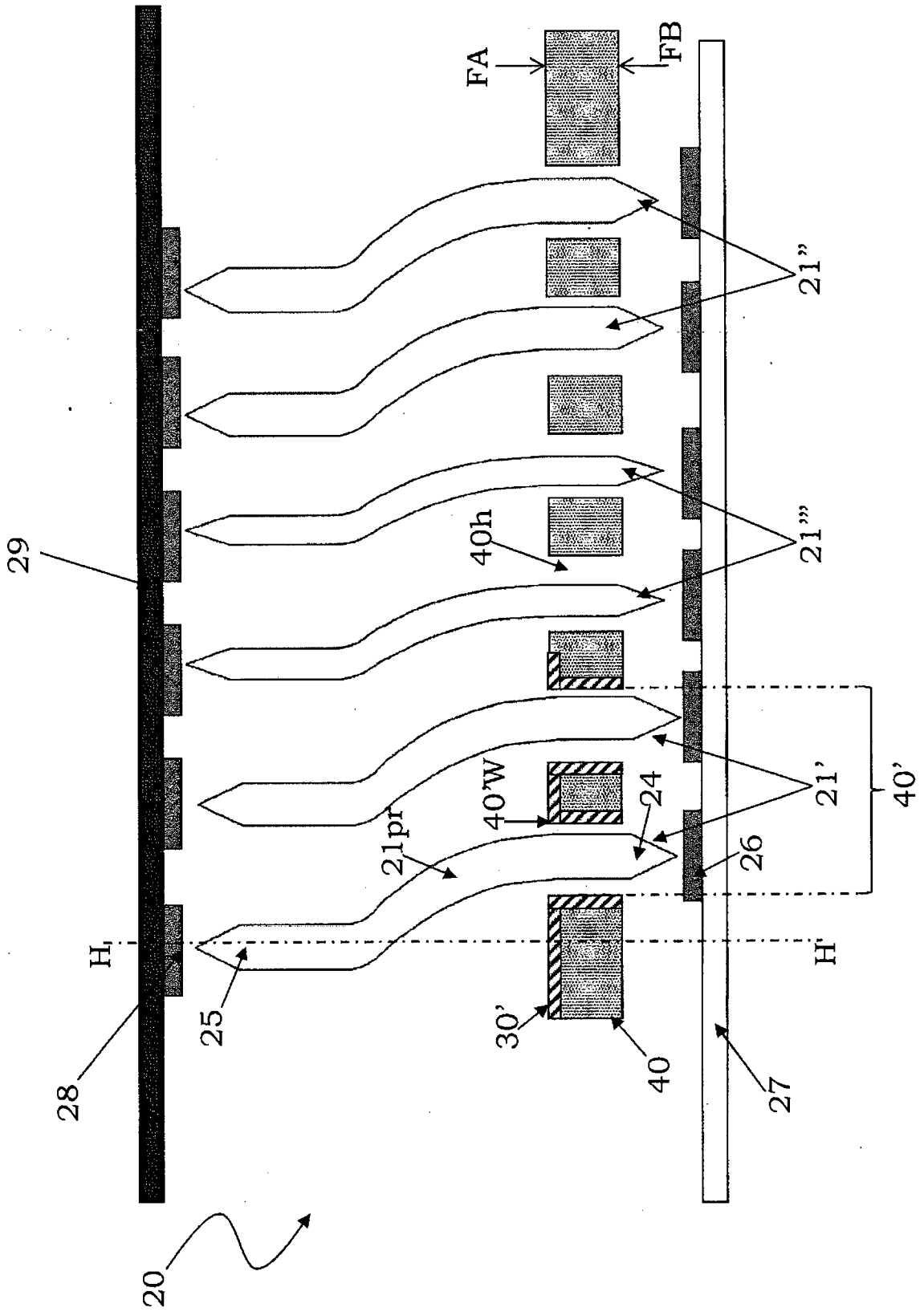


FIG. 2A

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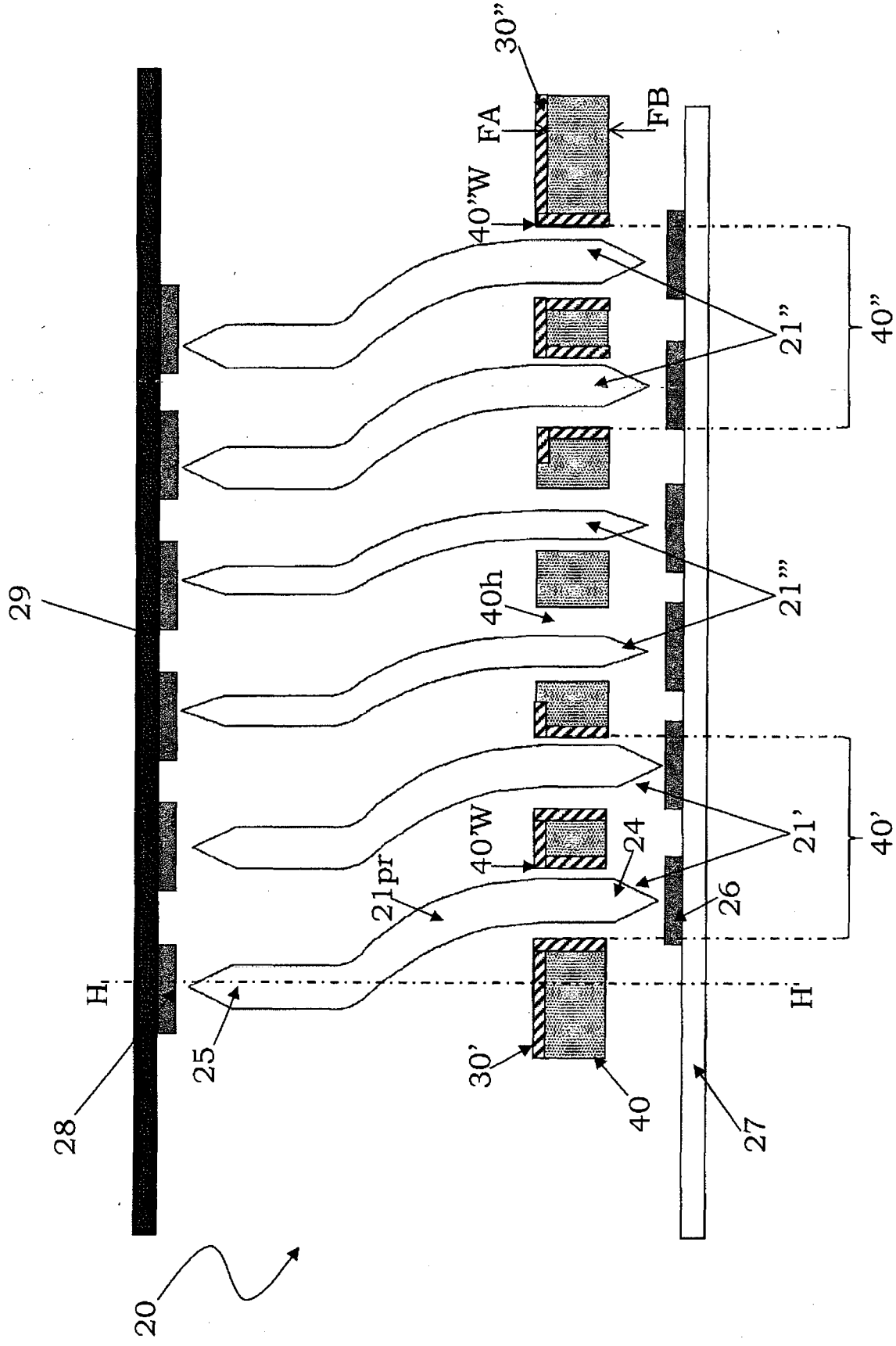


FIG. 2B

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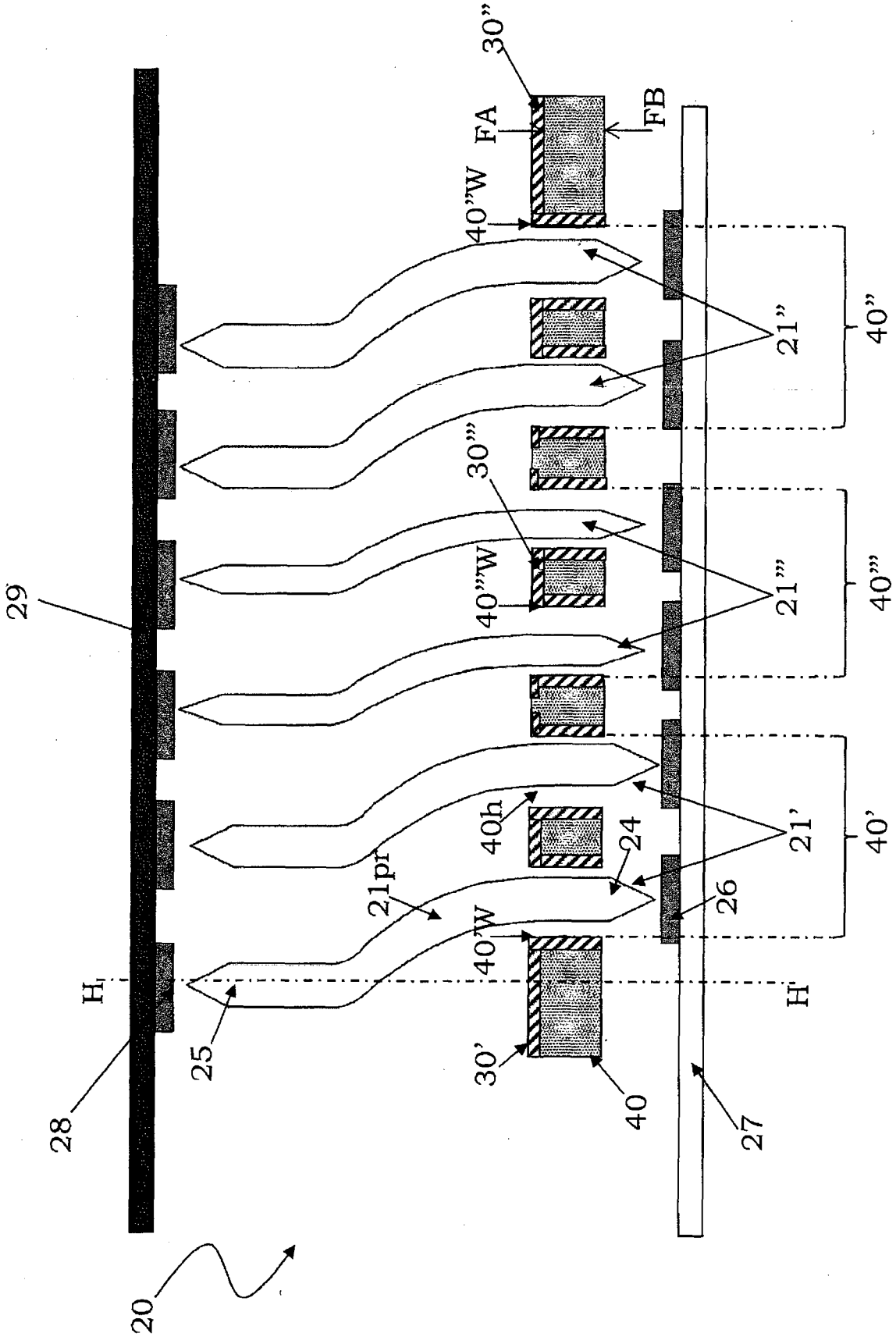


FIG. 2C

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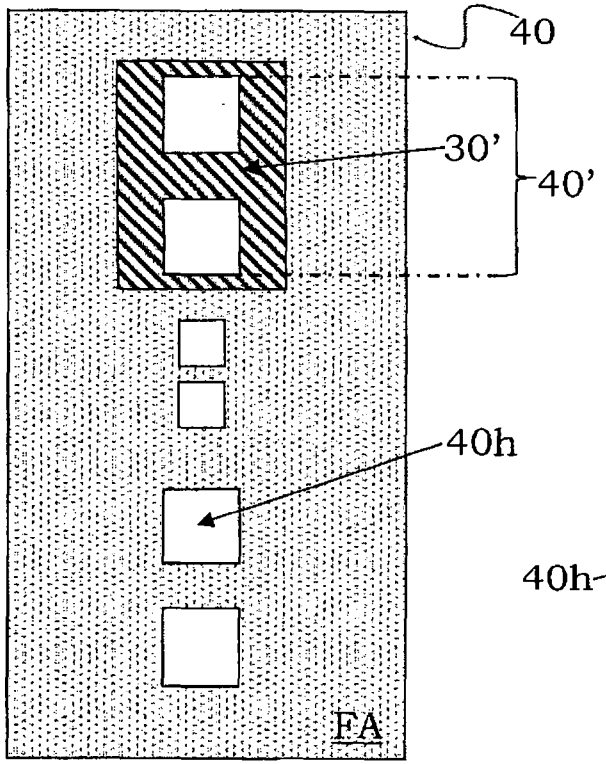


FIG. 3A

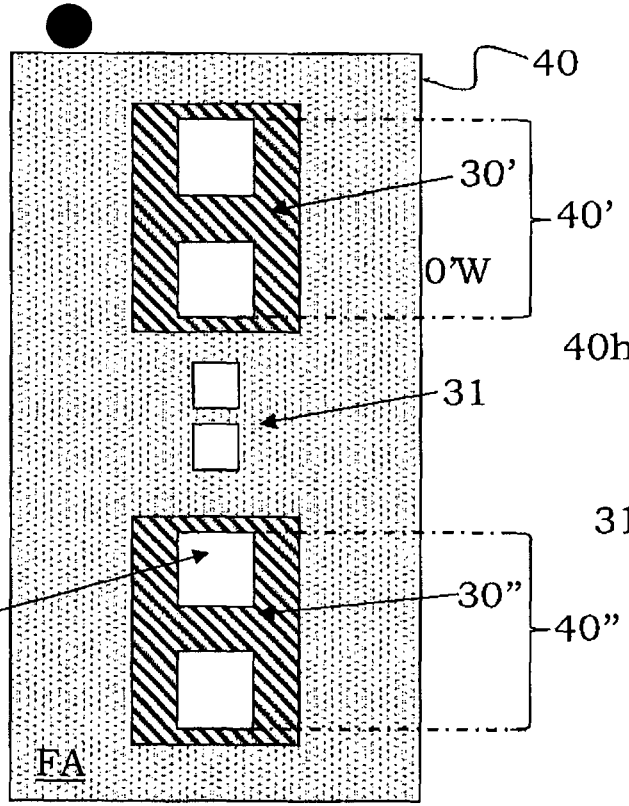


FIG. 3B

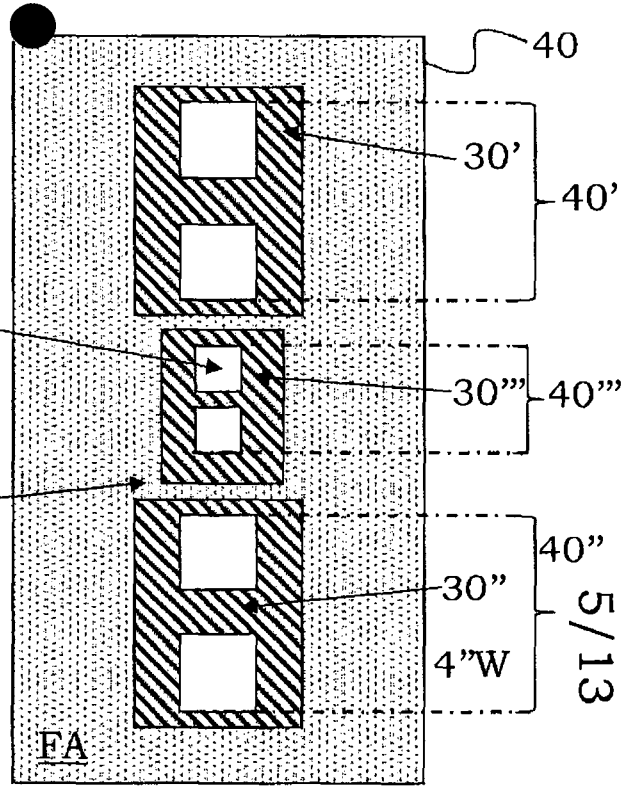


FIG. 3C

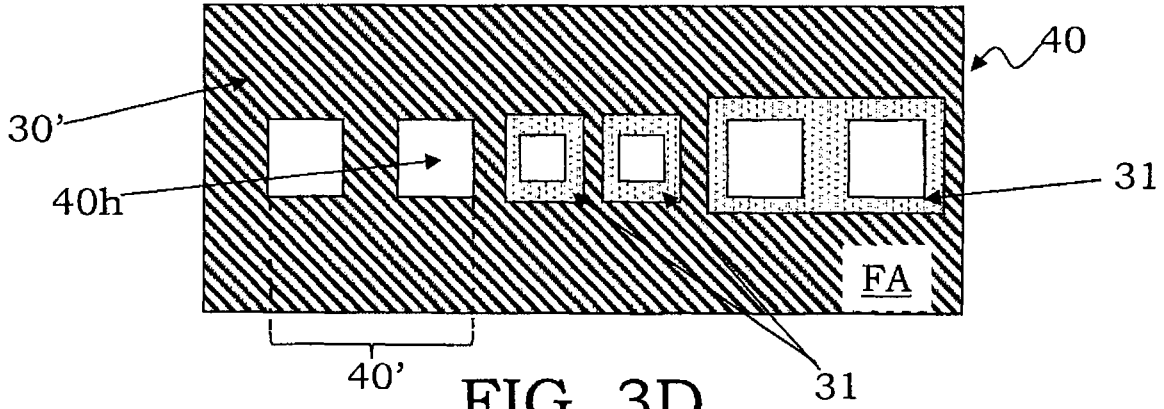


FIG. 3D

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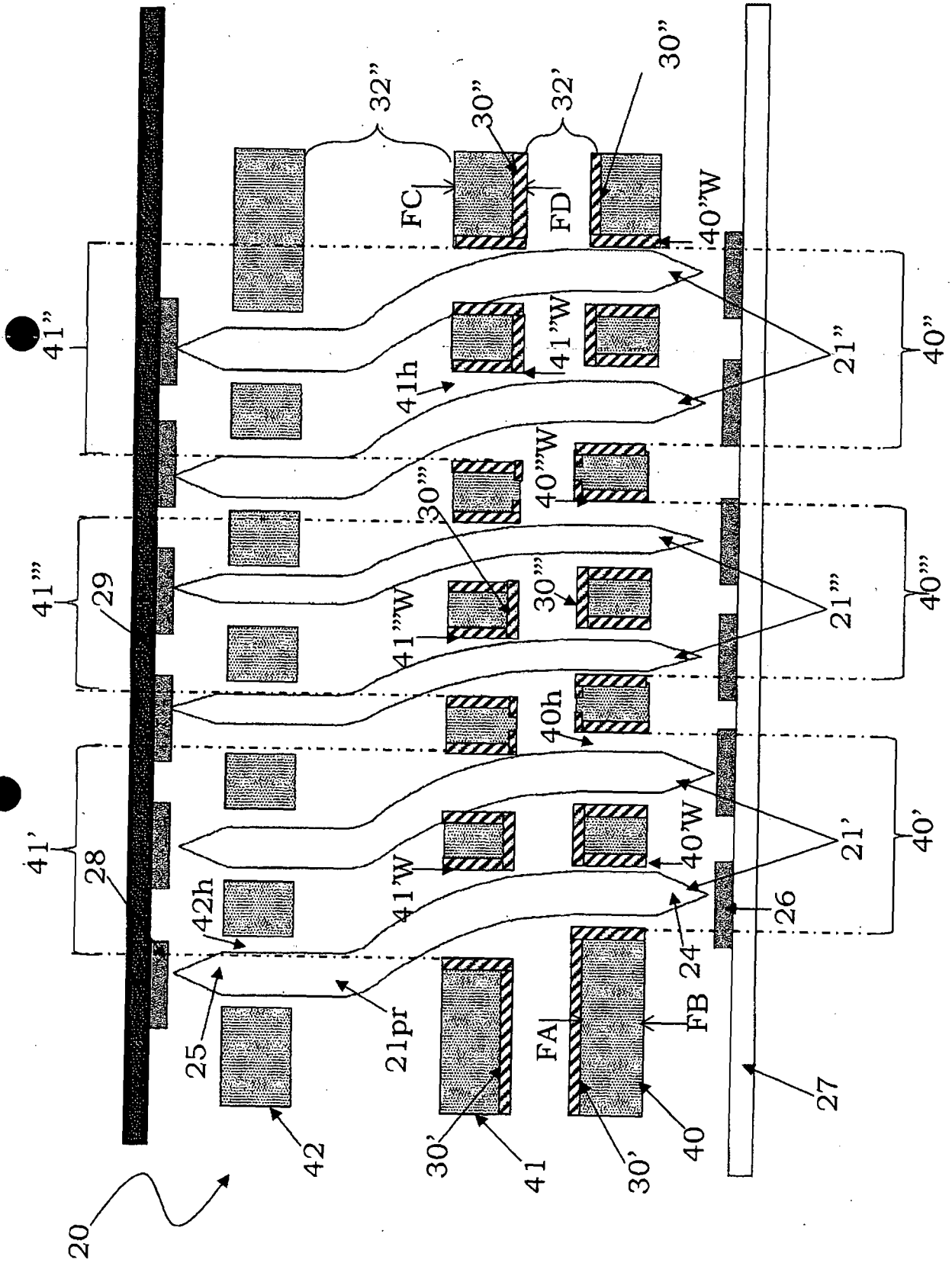


FIG. 4A

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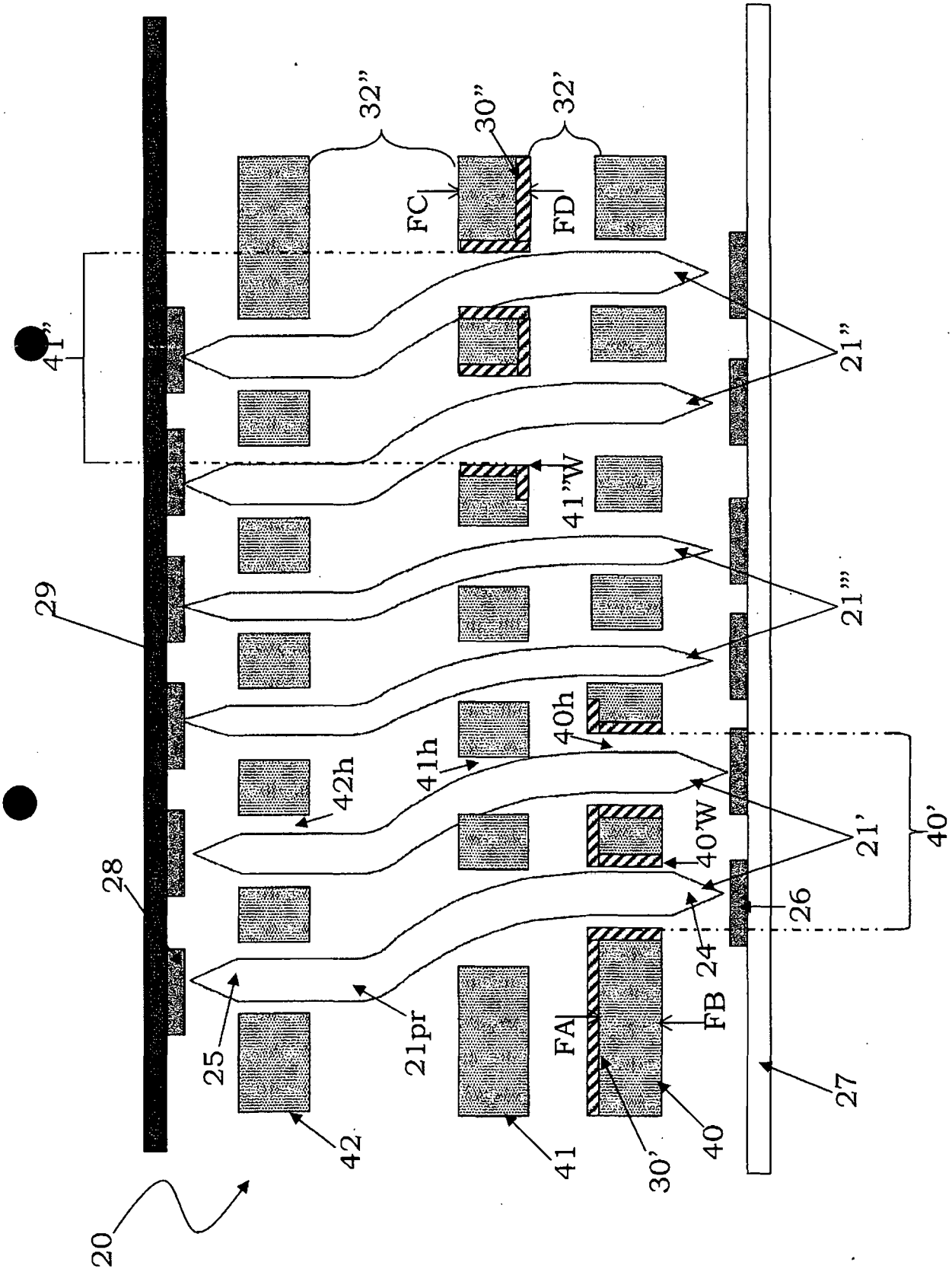


FIG. 4B

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FIG. 5A

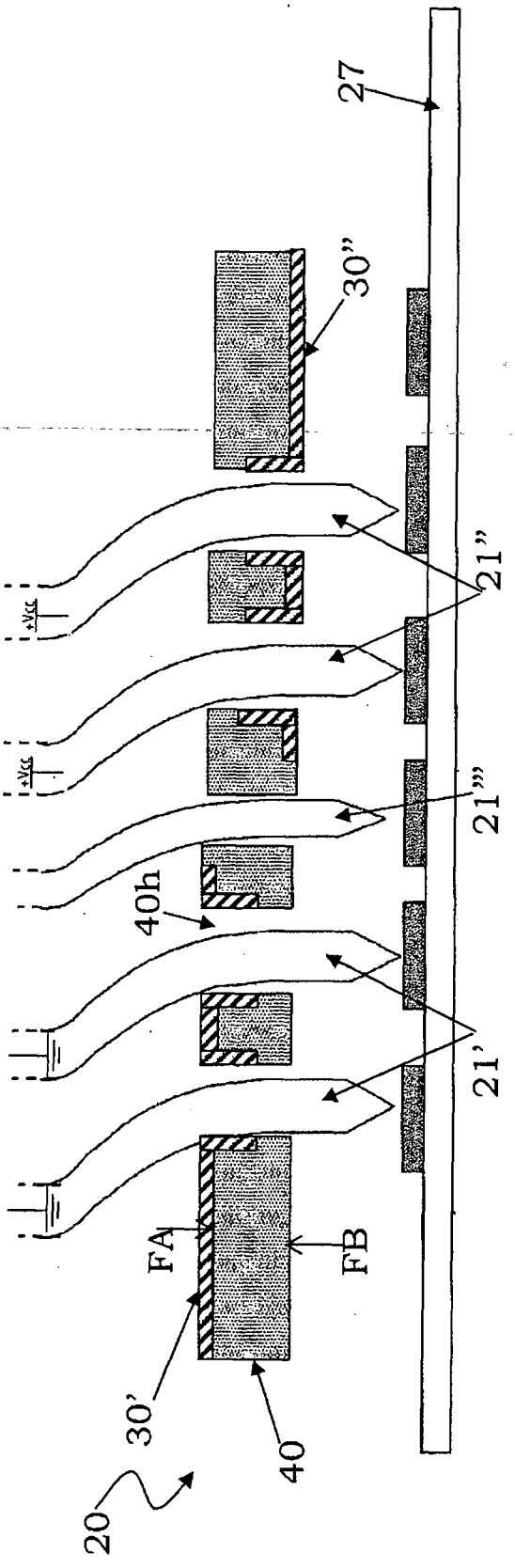
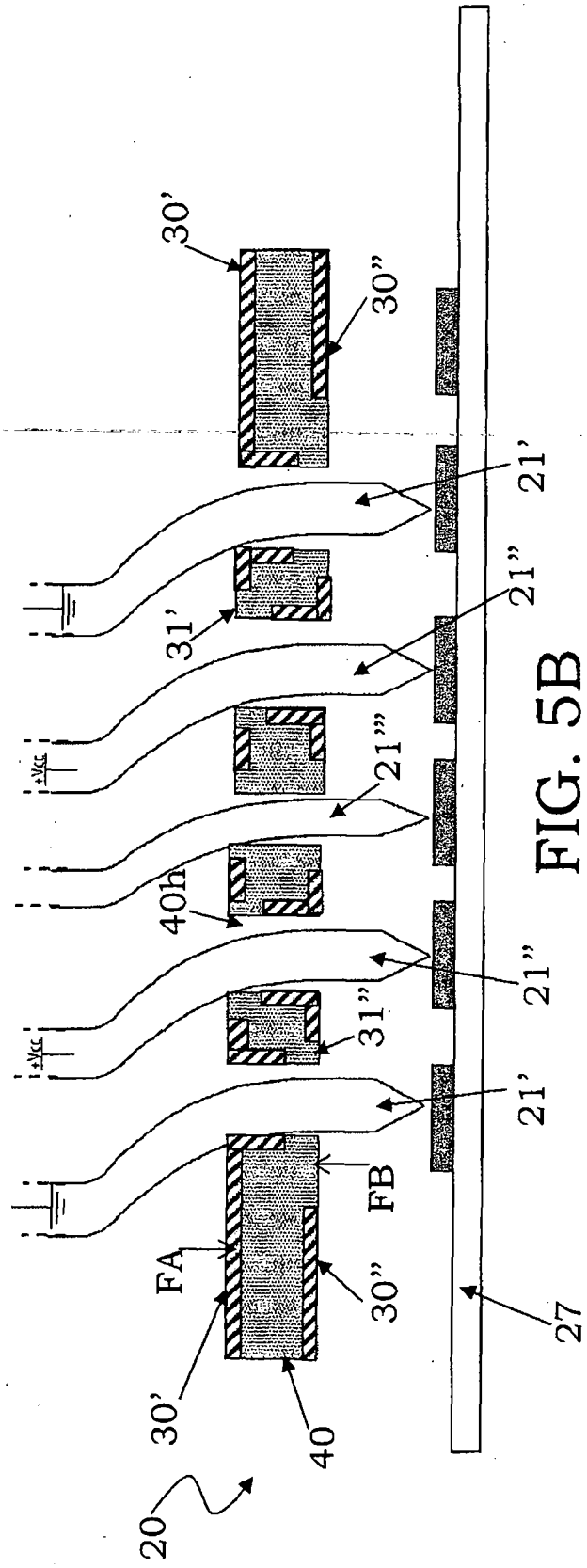


FIG. 5B



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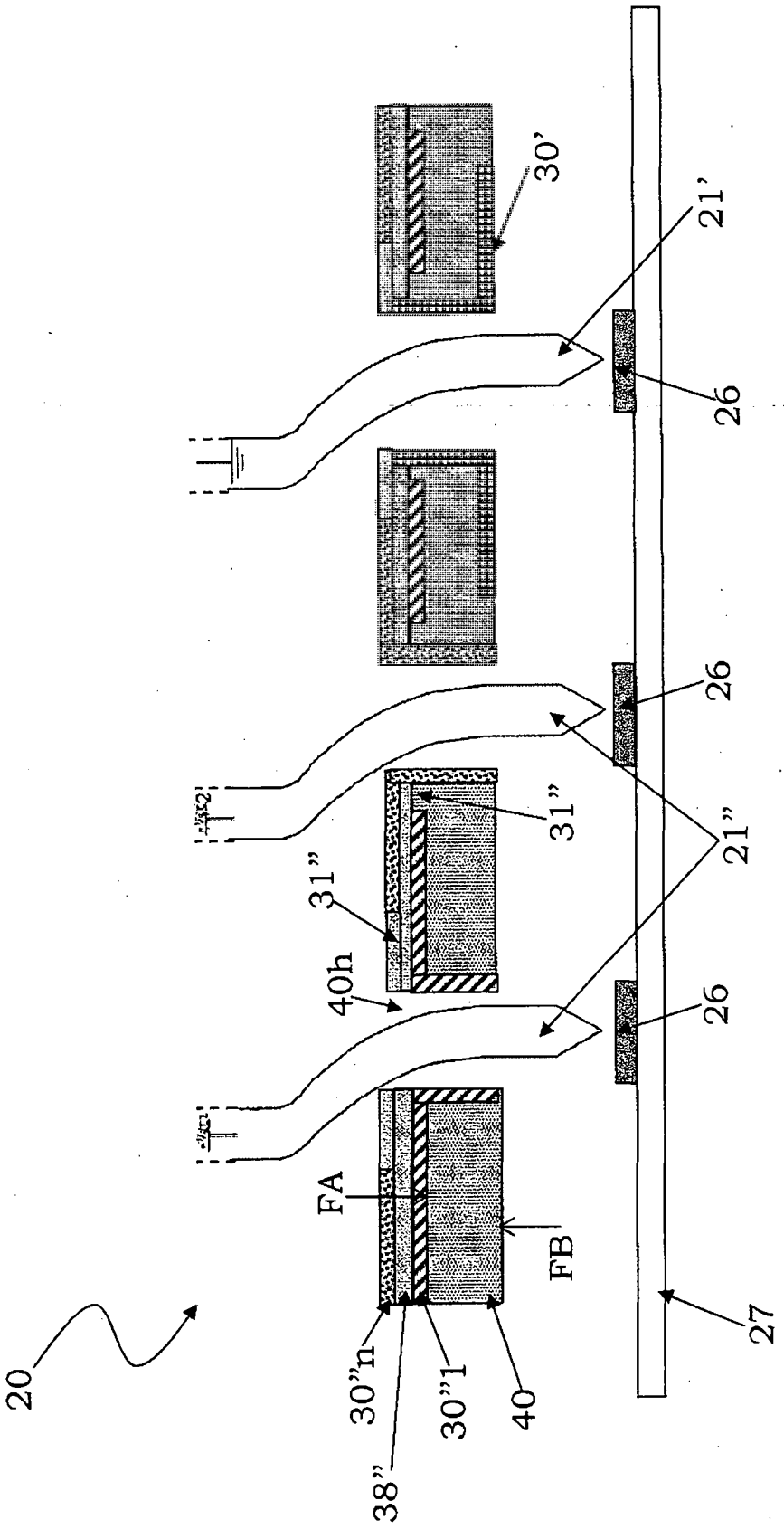


FIG. 6

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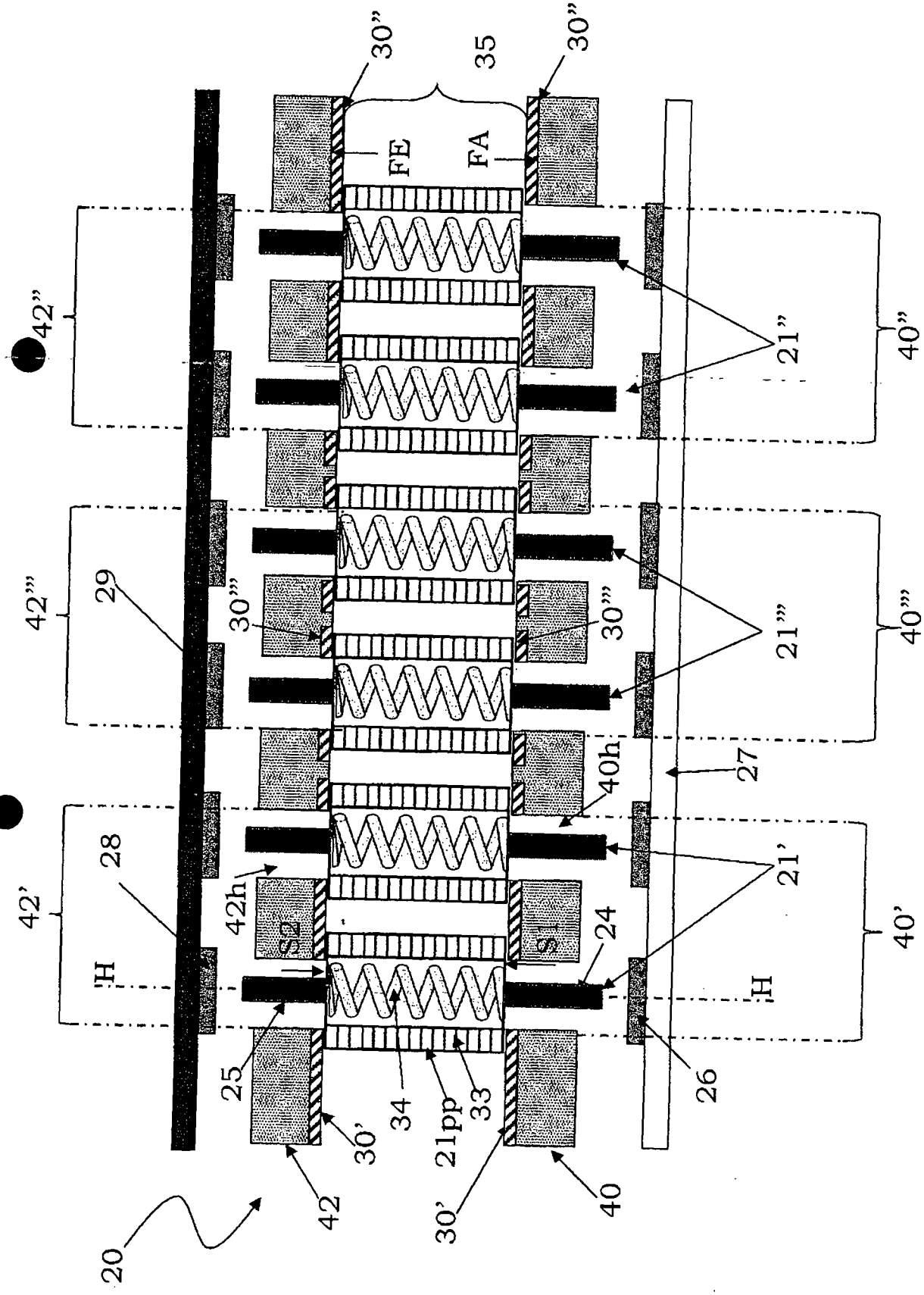


FIG. 7

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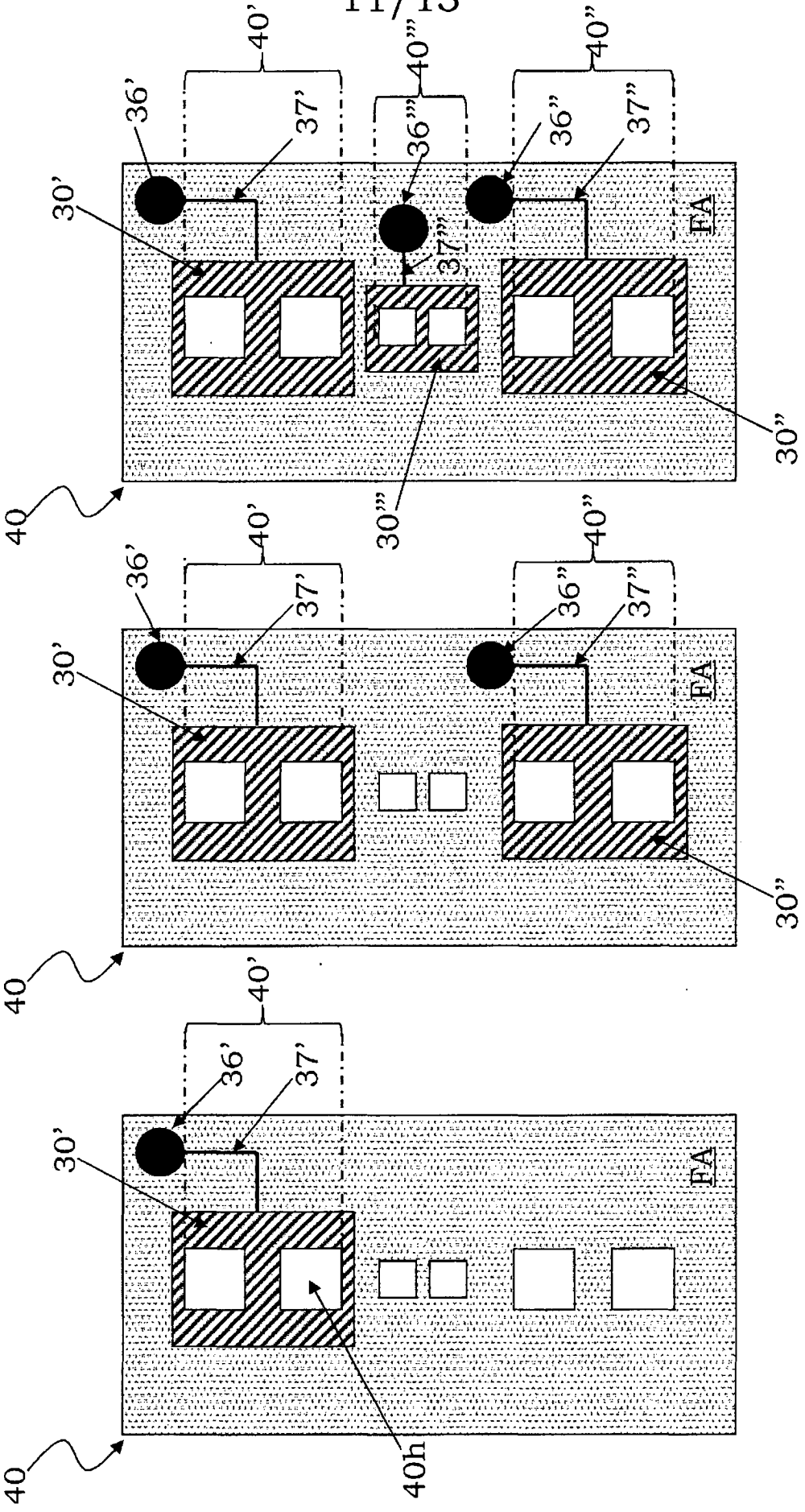


FIG. 8C

FIG. 8B

FIG. 8A

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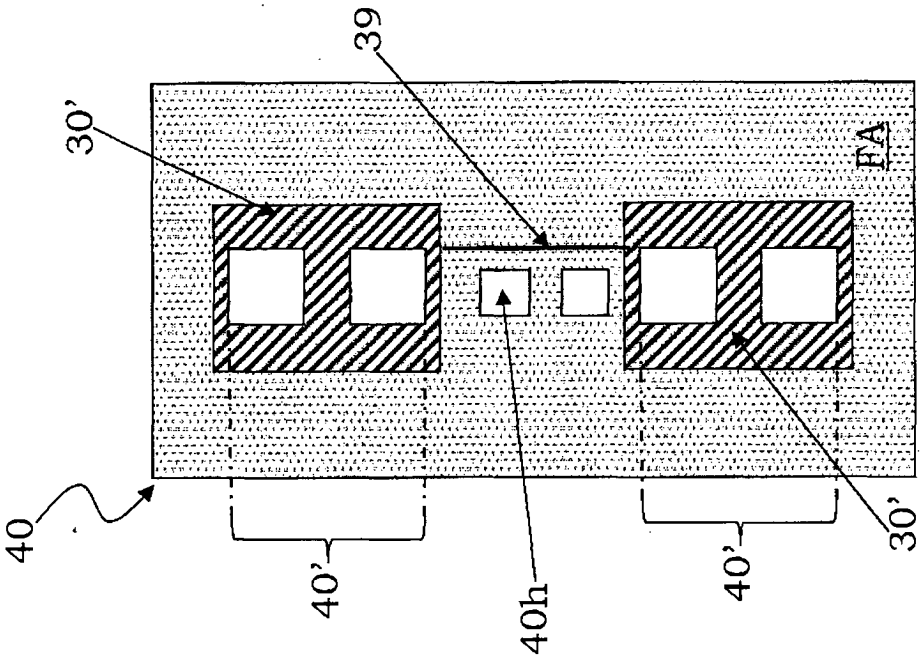


FIG. 9B

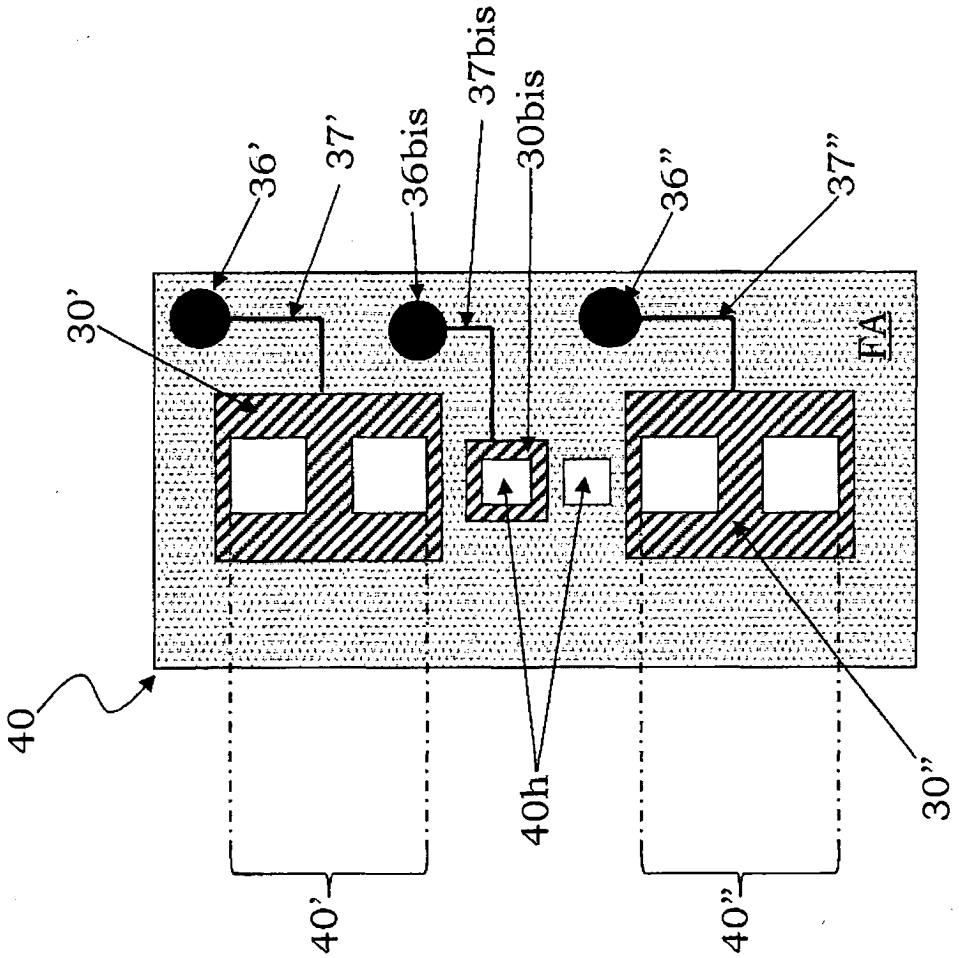


FIG. 9A

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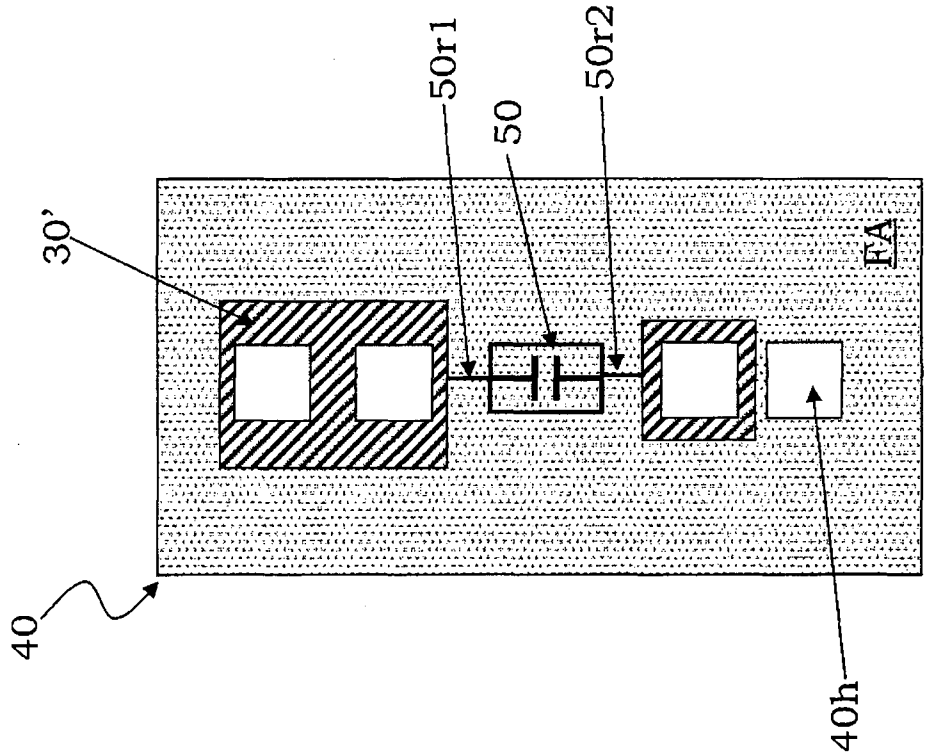


FIG. 10B

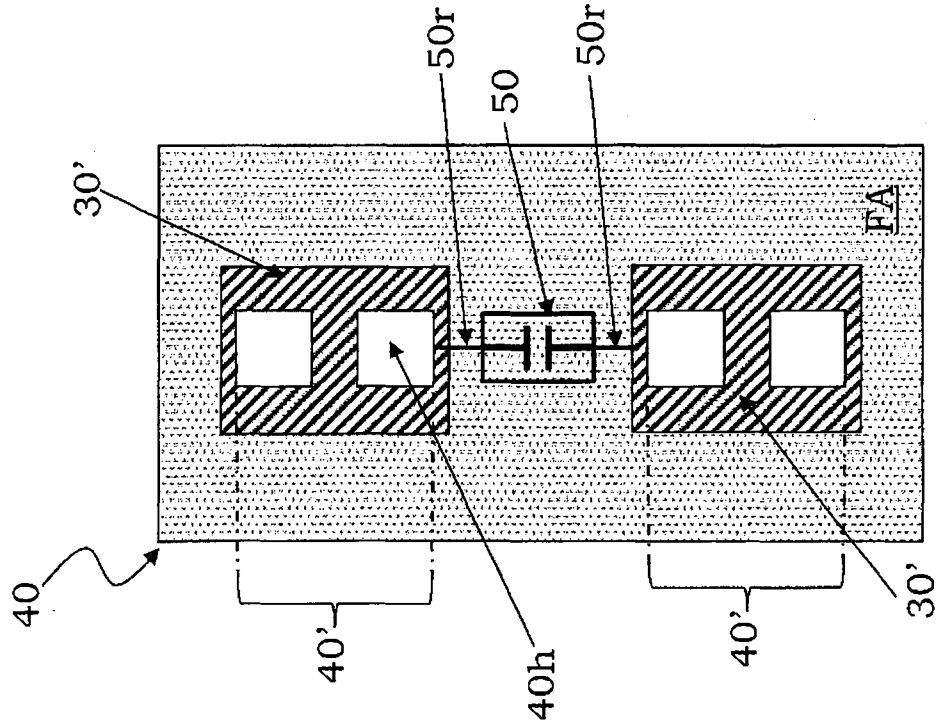


FIG. 10A

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GERMANY

Milano, October 8, 2018

Our ref.: ***TEC076BWO/BF/TS***

Re: Patent Application No. ***PCT/EP2017/082180*** *filed on* 11/12/2017 *and concerning a:* "Testing head having improved frequency properties" *in the name of:* ***TECHNOPROBE S.p.A.***

Dear Sirs,

With reference to the International Search Report and the Written Opinion issued on April 17, 2018 in connection with the above-identified patent application, we wish to submit the following amendments and observations.

1. Amendments

An amended set of claims under Art. 34 PCT is herewith enclosed to be substituted for the claims of the application as originally filed. The new set of claims has been revised in order to better point out and distinctly claim the present invention.

In particular, independent claim 1 has been rephrased to specify that the testing head comprises "a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h, 42h)", *and that the conductive portion* "includes and electrically connects the holes [...] and electrically connects a corresponding group of said contact elements", *as clearly stated throughout the description text of the present application. It is observed that these amendments overcome the clarity objections of Re Item VIII of the Written Opinion.*

Moreover, independent claim 1 has been amended to state that the guide "comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41', 42') of said guide holes (40h,

41h, 42h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h), wherein the contact elements of a same group are adapted to carry a same type of signal, and wherein the contact elements of different groups are adapted to carry different types of respective signals"*(emphasis added).*

Support for the above amendment can be found in originally filed dependent claim 2, as well as throughout the description text of the present application, where it is clearly and unambiguously disclosed that the contact elements of a same group are adapted to carry a same type of signal (e.g., ground, power or also operative signals), while the contact elements of different groups are adapted to carry a different type of signal.

Originally filed dependent claim 2 has been deleted, while originally filed dependent claims 3-22 have been renumbered as new dependent claims 2-21, the dependencies having been corrected accordingly.

Finally, specification page 4 has been amended in order to acknowledge prior art documents D1 (i.e. US 2012/0242360 A1), D2 (i.e. KR 101 421 051 B1), D3 (i.e. US 2014/0197860 A1), and D4 (i.e. WO 2012/106220 A1).

The annexes include the new set of claims and new specification page 4. Handmarked pages are included for the Examiner's convenience.

2. Observations

In the Written Opinion, the subject-matter of independent claim 1 of the present application is considered as not new in view of the teachings of document D1 (i.e. the aforementioned US patent application n. US 2012/0242360 A1).

The Applicant has duly considered the Examiner's objections and believes that claim 1 as amended is new and inventive over the cited prior art for the following reasons.

Document D1 discloses a probe card wherein the contact probes can be short-circuited by conductive layers (reference 202 or 204 in D1) arranged on a guide. In particular, the probe card of D1 is characterized by an inductive/capacitive coupling between high frequency probes and coupling metal probes, the latter being short-circuited by the above mentioned conductive layers.

However, it is observed that the conductive layers of document D1 are adapted to connect to each other only the coupling probes, i.e. only the probes surrounding the corresponding high-frequency probes, such coupling probes being all identical and no

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distinction between different short-circuited probes being suggested.

On the other hand, the present application provides that there are at least two conductive portions adapted to connect to each other respective different groups of contact probes which are adapted to carry a different type of signal. For example, according to the present patent application, one group can carry ground signals and the other group can carry power signals or also operative signals. This can also imply a physical difference among the short-circuited probes, as stated for example at pages 11 and 12 of the description text of the patent application in re: in case of power contact probes, it is possible to use wires having a larger diameter compared to the diameter of the wires that form the signal probes, as well as it is possible to use also different materials for different contact elements.

Summing up, document D1 does not disclose a first conductive portion and a second conductive portion respectively connecting probes carrying different signals, since clearly there is only one group of probes which is short-circuited.

It is further observed that also the Examiner acknowledges the novelty of the above-indicated feature of the present application, no prior art document disclosing or suggesting a guide equipped with at least two different conductive portions.

From the above considerations, it is thus concluded that the subject matter of independent claim 1 as amended is endowed with the required novelty under Art. 33(2) PCT with respect to document D1.

It is also respectfully remarked that the combination of features of new independent claim 1 has several advantages and that the present application is also inventive.

In particular, the present application provides a way to achieve an overall improvement of the frequency performances of the testing head. Advantageously, it is possible to short-circuit groups of probes without transporting the relative signal to the test equipment, said short-circuit preferably occurring at the lower and/or intermediate guide, i.e. close to the device under test. The different conductive portions represent a plurality of common planes, not only ground/power planes, but also signal planes. In the former cases, the common planes reduce inductance loops; in the latter case, the electrical connection between contact elements that carry operating signals improves the performances when there is a need to electrically connect two or more contact pads of the device under test, for example in the loop-back technique.

In document D1 there is no suggestion of short-circuiting different groups of probes by means of different conductive portions as instead provided in the present application. In fact, D1 discloses the presence of conductive portions for connecting only the coupling probes, with a different purpose than the patent application re.

Summing up, when faced with the technical problem of the present application, the

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skilled man would not have found any hint in D1 that would have prompted him to modify the card disclosed therein to obtain the solution of the present application.

In light of the above remarks, it is believed that the subject-matter of claim 1 is endowed with the required inventive step under Art. 33(3) PCT over document D1.

In the Written Opinion, the subject-matter of independent claim 1 of the present application is also considered as not new in view of the teachings of documents D2 (i.e. KR 101 421 051 B1), D3 (i.e. US 2014/0197860 A1) and D4 (i.e. WO 2012/106220 A1).

The Applicant respectfully remarks that the above indicated features of new independent claim 1, which distinguish it over document D1, are not disclosed nor suggested in documents D2-D4 either and that, starting from document D1, the skilled man would have not found in documents D2-D4 any teaching allowing him to fill the many differences between D1 and the patent application in re.

In particular, document D2 relates to a testing head wherein the guide holes of the guide comprise a metal portion in contact with the end portions of the contact probes. The Applicant points out that the metal portions of D2 are far from the conductive portions as claimed in the present application: the metal portions of D2 are clearly not intended to electrically connect different groups of probes that carry respective different types of signals, e.g. ground signals or power signals, as instead claimed in the present application.

Document D3 relates to a testing head comprising a guide equipped with a current-diverting circuit to which all the probes are connected. The current-diverting circuit of D3 comprises traces divided into primary branches (reference 52) and secondary branches (reference 54). Clearly, these branches are very far from the conductive portions of the present application, since all the probes of D3 are indistinctly connected to the diverting circuit and there is no mention of different contact probes carrying different types of signals.

Finally, document D4 discloses a socked for an integrated circuit allowing the setting of a plurality of power sources or grounds. It is observed that the socket of D4 is not comparable to a testing head comprising a guide adapted to house a plurality of contact probes, as instead claimed in the patent application in re. Therefore, although D4 shows different conductive layers, it discloses a socket having a completely different structure form the testing head of the present application. It is also observed that the layers of D4 are not used to improve the frequency performances of the system, as instead provided in the present application. Therefore, the skilled man, facing the problem tied to the frequency performances, would not consider D4 in order to obtain the invention disclosed in the present application.

In the light of the above remarks, it is thus believed that the subject-matter of

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independent claim 1 and of the claims depending thereon is endowed with the required novelty under Art. 33(2) PCT and with the required inventive step under Art. 33(3) PCT over documents D1-D4, taken alone or in combination.

*** ** * ** ***

In view of the amendments as filed and for all the above reasons, a positive international preliminary examination report established on the basis of here-enclosed new claims is expected.

In case there might remain any outstanding issues, we kindly ask the Examiner to timely issue an additional Written Opinion pursuant to Rule 66.4 PCT, before issuing the IPRP.

Many thanks and best regards.

Yours Sincerely,
The Representative
Barbara Ferrari

Encl.: new set of claims;
new specification page 4; and
handmarked pages

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PCT Demand - Fee Sheet

1. Applicant's or agent's file reference	TEC076BWO		
2. International application number	PCT/EP2017/082180		
3. Date	11-10-2018		
4. Method of payment	Debit from deposit account		
Deposit account number:	28070103		
Deposit account holder:	BOTTI & FERRARI S.r.l.		
The European Patent Office is hereby authorised to debit from the above indicated deposit account the total fees:	Yes		
Authorisation to charge any deficiency or credit any overpayment in the total fees:	Yes		
Name:	FERRARI Barbara		
Signature:	/Barbara Ferrari/		
5. Fees			
Fee type	**Currency**	**Fee**	**Total**
Fee for preliminary examination of int. application	EUR	1830.00	1830.00
Handling fee	EUR	175.00	175.00
Total	EUR		2005.00

In the case of a testing head of the kind described above, it is well known that the presence of several contact elements adapted to carry ground signals, as well as the presence of contact elements adapted to carry power signals, creates interferences, therefore causing noise in the input/output signals used for the test of the device under test, which limits the frequency performance of the testing head. In the case of contact elements adapted to carry ground signals, disadvantageous ground loops may also occur.

The possible necessity of shorting two or more contact pads of the device under test is also known. According to a known solution, known in the field as "loop-back", it is possible to short two contact pads of the device under test by means of the contact probes of the testing head, wherein a first probe carries a signal from a first pad of the device under test towards the test equipment and then the signal is closed on a second pad of the device under test by means of a second contact probe which contacts said second pad. In this case, however, the long path of the signal from the device under test to the test equipment and vice versa causes a reduction of the frequency performance of the testing head.

Conductive structures adapted to electrically connect contact probes to each other are disclosed for example in US 2012/0242360 A1, KR 101 421 051 B1, US 2014/0197860 A1, and WO 2012/106220 A1.

~~The~~ However, the need to improve the frequency performances of a testing head is ~~therefore~~ strongly felt in this technical field.

The technical problem of the present invention is to provide a testing head having structural and functional features such as to allow overcoming the limitations and drawbacks still affecting the known solutions, in particular able to reduce a simple way (and to eliminate in a simple way too) the interferences, and therefore the noise, caused by the presence of ground and power contact elements, as well as able to allow an electrical connection between contact pads of a device under test without reducing the frequency performances of the testing head itself.

Summary of the invention

In the case of a testing head of the kind described above, it is well known that the presence of several contact elements adapted to carry ground signals, as well as the presence of contact elements adapted to carry power signals, creates interferences, therefore causing noise in the input/output signals used for the test of the device under test, which limits the frequency performance of the testing head. In the case of contact elements adapted to carry ground signals, disadvantageous ground loops may also occur.

The possible necessity of shorting two or more contact pads of the device under test is also known. According to a known solution, known in the field as "loop-back", it is possible to short two contact pads of the device under test by means of the contact probes of the testing head, wherein a first probe carries a signal from a first pad of the device under test towards the test equipment and then the signal is closed on a second pad of the device under test by means of a second contact probe which contacts said second pad. In this case, however, the long path of the signal from the device under test to the test equipment and vice versa causes a reduction of the frequency performance of the testing head.

Conductive structures adapted to electrically connect contact probes to each other are disclosed for example in US 2012/0242360 A1, KR 101 421 051 B1, US 2014/0197860 A1, and WO 2012/106220 A1.

However, the need to improve the frequency performances of a testing head is strongly felt in this technical field.

The technical problem of the present invention is to provide a testing head having structural and functional features such as to allow overcoming the limitations and drawbacks still affecting the known solutions, in particular able to reduce a simple way (and to eliminate in a simple way too) the interferences, and therefore the noise, caused by the presence of ground and power contact elements, as well as able to allow an electrical connection between contact pads of a device under test without reducing the frequency performances of the testing head itself.

Summary of the invention

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TEC076BWO

CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h), and a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h, 42h), each of said contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), said testing head (20) being characterized in that said at least one guide (40, 41, 42) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h), wherein the contact elements of a same group are adapted to carry a same type of signal, and wherein the contact elements of different groups are adapted to carry different types of respective signals.

2. The testing head (20) according to claim 1, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

3. The testing head (20) according to claim 1 or 2, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41, 42), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41, 42).

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4. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

5. The testing head (20) according to claim 4, characterized in that said at least one guide (40, 41, 42) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

6. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

7. The testing head (20) according to any one of the claims from 1 to 5, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"),

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said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

8. The testing head (20) according to claim 6 or 7, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

9. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30"') that includes and electrically connects the holes of a third group (40"', 41"', 42"') of said guide holes (40h, 41h, 42h) to each other, said third group (40"', 41"', 42"') housing third contact elements (21"').

10. The testing head (20) according to claim 9, characterized in that said third contact elements (21"') housed in said third group (40"', 41"', 42"') of said guide holes (40h, 41h, 42h) are adapted to carry input/output signals between the device under test and a test equipment.

11. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') covers at least one portion (40'W, 40"W , 40"'W; 41'W, 41"W, 41"'W) of an inner surface of each guide hole of said group (40', 40", 40"'; 41', 41", 41"') of said guide holes (40h, 41h).

12. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21"') are contact probes wherein said body (21pr) has a deformation.

13. The testing head (20) according to any one of the claims from 1 to 5, characterized in that said contact elements (21', 21", 21"') are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1)

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and a second surface (S2), at least one of said surfaces (S1, S2) being apt to abut onto said at least one guide (40, 42), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said first and/or second surface (S1, S2).

14. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42).

16. The testing head (20) according to any one of the claims from 1 to 14, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41, 42), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") are formed.

17. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h, 42h) apt to house a single contact element, said at least one guide (40, 41, 42) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive

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portion (30bis) to other conductive portions.

18. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41, 42).

19. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') comprises a plurality of conductive portions overlapped to and electrically insulated from each other.

20. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h, 42h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21"'), said contact elements included in said respective groups being adapted to carry a same type of signal.

21. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41, 42).

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CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h), ~~adapted to house~~and a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h, 42h), each of said contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), said testing head (20) being characterized in that said at least one guide (40, 41, 42) comprises at least one first conductive portion (30'~~, 30", 30'"~~) that includes ~~and electrically connects~~ the holes of at least one first group (40'~~, , 40"; 40'"~~; 41'~~,; 41", 41'"~~; 42'~~, 42", 42'"~~) of said guide holes (40h, 41h, 42h) and electrically connects ~~to each other and is apt to contact~~ a corresponding first group of said contact elements (21'~~, 21", 21'"~~) housed in said at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h), wherein the~~said~~ contact elements ~~(21', 21", 21'")~~ of a same~~said corresponding~~ group are~~being~~ adapted to carry a same type of signal, and wherein the contact elements of different groups are adapted to carry different types of respective signals.

~~2. The testing head (20) according to claim 1, characterized in that it comprises at least one first conductive portion (30') and at least one second conductive portion (30"), said first conductive portion (30') including and electrically connecting the holes of a first group (40', 41', 42') of said guide holes (40h, 41h, 42h) to each other, said first group (40', 41', 42') housing first contact elements (21'), said second conductive portion (30") including and electrically connecting the holes of a second group (40", 41", 42") of said guide holes (40h, 41h, 42h) to~~

~~each other, said second group (40", 41", 42") housing second contact elements (21").~~

~~32~~. The testing head (20) according to claim ~~21~~, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

~~43~~. The testing head (20) according to claim ~~2~~ 1 or ~~32~~, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41, 42), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41, 42).

~~54~~. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

~~65~~. The testing head (20) according to claim ~~54~~, characterized in that said at least one guide (40, 41, 42) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

~~76~~. The testing head (20) according to any one of the preceding claims ~~claim 2~~, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and

said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

~~8~~7. The testing head (20) according to any one of the claims from 1 to 5 ~~claim 2~~, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"), said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

~~9~~8. The testing head (20) according to claim ~~7~~6 or ~~8~~7, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

~~10~~9. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30'") that includes and electrically connects the holes of a third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, said third group (40'", 41'", 42'") housing third contact elements (21'").

~~11~~10. The testing head (20) according to claim ~~10~~9, characterized in that said third contact elements (21'") housed in said third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) are adapted to carry input/output signals between the device under test and a test equipment.

~~12~~11. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") covers at least one portion (40'W, 40"W , 40'"W; 41'W, 41"W, 41'"W) of an inner surface of each guide hole of said group (40', 40", 40'"; 41', 41", 41'") of said guide holes (40h, 41h).

~~13~~12. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21'") are contact probes wherein said body (21pr) has a deformation.

~~14~~13. The testing head (20) according to any one of the claims from 1 to ~~6~~5, characterized in that said contact elements (21', 21", 21'") are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1, S2) being apt to abut onto said at least one guide (40, 42), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said first and/or second surface (S1, S2).

~~15~~14. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

~~16~~15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one

guide (40, 41, 42) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42).

~~17~~16. The testing head (20) according to any one of the claims from 1 to ~~15~~14, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41, 42), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") are formed.

~~18~~17. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h, 42h) apt to house a single contact element, said at least one guide (40, 41, 42) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

~~19~~18. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30'") is embedded in said at least one guide (40, 41, 42).

~~20~~19. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") comprises a plurality of conductive portions overlapped to and electrically insulated from each other.

~~21~~20. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said

guide holes (40h, 41h, 42h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21'"), said contact elements included in said respective groups being adapted to carry a same type of signal.

2221. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41, 42).

PCT DEMAND FOR INTERNATIONAL PRELIMINARY EXAMINATION (CHAPTER II)

0	**For International Preliminary Examining Authority use only**	
0-1	Identification of IPEA	EP
0-2	Date of receipt of DEMAND	11.10.2018

0-3	**Form - PCT/IPEA/401 PCT Demand**	
0-3-1	Prepared Using	eOLF Version: FMMNGR5169, IBR4015160, FM_FOP0205
0-4	**Demand under Article 31 of the Patent Cooperation Treaty:** The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).	
0-5	**International Preliminary Examining Authority (specified by the applicant)**	IPEA/EP
I	**Identification of the International application**	
I-1	International Application No.	PCT/EP2017/082180
I-2	International Filing Date	11 December 2017 (11.12.2017)
I-3	(Earliest) Priority Date	16 December 2016 (16.12.2016)
I-4	Applicant's or agent's file reference	TEC076BWO
I-5	Title of Invention	Testing head having improved frequency properties

PCT DEMAND FOR INTERNATIONAL
PRELIMINARY EXAMINATION (CHAPTER II)

II-1	**Applicant**	
II-1-1	Name	TECHNOPROBE S.p.A.
II-1-2	Address	Via Cavalieri di Vittorio Veneto, 2 23870 Cernusco Lombardone (Lecco) Italy
II-1-3	State of nationality	IT
II-1-4	State of residence	IT
II-1-5	Telephone No.	
II-1-6	Facsimile No.	
II-1-7	e-mail	
II-1-8	Applicant's registration No. with the Office	
III-1	**Agent or common representative; or address for correspondence**	
	The person identified below is hereby/ has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	Agent (appointed earlier)
III-1-1	Name (LAST, First)	FERRARI, Barbara
III-1-1a	Attn., c/o	BOTTI & FERRARI S.r.l.
III-1-2	Address	Via Cappellini, 11 20124 Milano Italy
III-1-3	Telephone No.	+39 02 6704275
III-1-4	Facsimile No.	+39 02 6703250
III-1-5	e-mail	
III-1-6	Agent's registration No.	
IV	**Basis for International Preliminary Examination**	
IV-1-1	Statement concerning amendments: The applicant wishes the International Preliminary Examination to start on the basis of:	-the description as amended under Article 34 -the claims as amended under Article 34 -the drawings as originally filed
IV-2	Language for the purposes of international preliminary examination:	English -(which is the language of publication of the international application)

PCT DEMAND FOR INTERNATIONAL PRELIMINARY EXAMINATION (CHAPTER II)

V	**Election of States**	The filing of this demand constitutes the election of all Contracting States which are designated and are bound by Chapter II of the PCT.		
VI	**Check list** **The demand is accompanied by the following elements, in the language referred to under item IV-2 for the purposes of international preliminary examination:**	Number of sheets	Electronic file(s) attached	**Received Y/N (For IPEA use only)**
VI-2 (1)	Amendments under Art. 34	6	**AMDA34-1**	
VI-6	Letter accompanying the amendments under Article 34 (Rule 66.8)	5	**LETT.pdf**	
VI-7	Other : Amendments art 34 with annotations	7	**OTHERDOC-1.pdf**	
	Accompanying Items **The demand is also accompanied by the following item(s):**	Details	Electronic file(s) attached	**Received Y/N (For IPEA use only)**
VI-8	Fee calculation sheet	1	**fees.pdf**	
VII-1	**Signature of applicant, agent or common representative**	PKCS7 Digital Signature: Barbara Ferrari 6913		
VII-1-1	Name (First, Last)	Barbara FERRARI		
VII-1-2	Capacity	Representative		
VIII	**Note(s) to IPEA/EP**			

PCT DEMAND FOR INTERNATIONAL
PRELIMINARY EXAMINATION (CHAPTER II)

FOR INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY USE ONLY

8-1	Date of actual receipt of DEMAND	11.10.2018
8-2	Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b)	
8-3	The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and items 8-4 and 8-5 below do not apply.	X
8-3-1	The applicant has been informed accordingly	X
8-4	The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.	
8-5	Although the date of receipt of the demand is after the expiration of the 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.	
8-6	The date of receipt of the demand is AFTER the expiration of the time limit under Rule 54bis, 1(a) and item 7 or 8, below, does not apply.	
8-7	The date of receipt of the demand is WITHIN the time limit under Rule 54bis.1(a) as extended by virtue of Rule 80.5.	
8-8	Although the date of receipt of the demand is after the expiration of the time limit under Rule 54bis.1(a), the delay in arrival is EXCUSED pursuant to Rule 82.	

FOR INTERNATIONAL BUREAU USE ONLY

9-1	Demand received from IPEA on	

Europäisches Patentamt
European Patent Office
Office européen des brevets

Acknowledgement of receipt

We hereby acknowledge receipt of your Demand under Article 31 of the Patent Cooperation Treaty (PCT):

Submission number	6798534	
Application number	PCT/EP2017/082180	
Date of receipt	11 October 2018	
Filing Office / capacity	European Patent Office, The Hague	IPEA
Your reference	TEC076BWO	
Applicant	All applicants as on file	
Documents submitted	package-data.xml fee-sheet.xml pct-demand.pdf (4 p.) validation-log.xml AMDA34-1.pdf (6 p.) OTHERDOC-1.pdf (7 p.)	demand.xml fees.pdf (1 p.) ValidLog.pdf (1 p.) olf-specific-data.xml LETT.pdf (5 p.)
Submitted by	CN=Barbara Ferrari 6913	
Method of submission	Online	
Date and time receipt generated	11 October 2018, 12:03 (CEST)	
Message Digest	10:13:CA:1B:E6:0B:FB:F4:83:A0:AB:59:EC:D3:65:5C:30:00:31:7B	

Correction by the EPO of errors in debit instructions filed by eOLF

Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged according to point 6.3 ff

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ADA, Supplement to OJ EPO 3/2014 (see decision T 152/82, OJ EPO 1984, 301).

/European Patent Office/

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

FERRARI, Barbara
BOTTI & FERRARI S.R.L.
Via Cappellini, 11
I-20124 Milano
ITALIE

NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(e) and 61.1(b), first sentence and Administrative Instructions, Section 601(a))

Date of mailing *(day/month/year)*	09.11.2018
Applicant's or agent's file reference TEC076BWO	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2017/082180	11 December 2017 (11-12-2017)	16 December 2016 (16-12-2016)

Applicant

Technoprobe S.p.A

1. The applicant is hereby **notified** that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

11 October 2018 (11-10-2018)

2. This date of receipt is:

- [X] the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- [ ] the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- [ ] the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. [X] **ATTENTION:** That date of receipt is **after** the expiration of 19 months from the priority date. Consequently, in respect of some Offices, the demand does not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)) and the acts for entry into the national phase must therefore be performed within 20 months from the priority date (or later in some Offices). **However,** in respect of some other Offices, the time limit of 30 months (or later) may nevertheless apply. See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide,* Volume II, National Chapters and the WIPO Internet site.

- [ ] *(If applicable)* This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Fax: (+49-89) 2399-4465	Choulouilidou, Chrissanthi Tel: (+49-89)2399-2257

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PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Article 31(7) and Rule 61.2)

To:

European Patent Office
Postbus 5818
Patentlaan 2
NL-2280 HV RIJSWIJK
PAYS-BAS
in its capacity as elected Office

Date of mailing *(day/month/year)* 06 December 2018 (06.12.2018)	
International application No. PCT/EP2017/082180	Applicant's or agent's file reference TEC076BWO
International filing date *(day/month/year)* 11 December 2017 (11.12.2017)	Priority date *(day/month/year)* 16 December 2016 (16.12.2016)
Applicant TECHNOPROBE S.P.A.	

1. The designated Office is hereby notified of its election made in the demand filed with the International Preliminary Examining Authority on:
   11 October 2018 (11.10.2018)

2. The election ☐ was

   ☒ was not

   made before the expiration of 19 months from the priority date (PCT Article 39(1)(a)).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. +41 22 338 82 70

Authorized officer

Nora Lindner

e-mail: pct.team5@wipo.int

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Box No. I Basis of the opinion

1. With regard to the **language** , this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into ,
   which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3(a) and 23.1(b)).
   - ☐ publication of the international application (under Rule 12.4(a))
   - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a) and (b))

2. With regard to the elements of the international application, this opinion has been established on the basis of *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed")*:

   Description, Pages

   1-32 as originally filed

   Claims, Numbers

   1-22 as originally filed

   Drawings, Sheets

   1/13-13/13 as originally filed

   ☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:

4. ☐ This opinion has been established as if (some of) the amendments listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-*bis*)):
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:

5. ☐ This opinion has been established:
   - ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 66.1(d-*bis*)).
   - ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 66.4*bis*).

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6. ☐ Supplementary international search report(s) from Authority(ies) have been received and taken into account in drawing up this opinion (Rule 45*bis*.8(b) and (c)).

Box No. V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	No:	Claims	
Inventive step (IS)	No:	Claims	1-21
Industrial applicability (IA)	No:	Claims	

2. Citations and explanations:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27)

D2 KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22)

D3 US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17)

D4 WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09)

2 Novelty, inventive step.

2.1 Independent claim 1.

2.1.1 D2 is considered at present as the closest prior art and discloses:

A testing head (Figs. 3, 4) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (11, 12) provided with a plurality of guide holes (11b, 11b', 12b, 12b') and a plurality of contact elements (20) housed in said guide holes, each of said contact elements comprising a body (30) that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one first conductive portion (40a, 40b) that includes the holes of at least one first group of said guide holes and electrically connects (see Fig. 4, corresponding to G connection) a corresponding first group of said contact elements housed in said at least one first group of said guide holes, and

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~~at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,~~

wherein the contact elements of a same (here the first group as defined in D2) group are adapted to carry a same type of signal, and

~~wherein the contact elements of different groups are adapted to carry different types of respective signals.~~

2.1.2 The subject-matter of claim 1 differs from D2 in that the testing head further comprises:

at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,

wherein the contact elements of a same (here the second group) group are adapted to carry a same type of signal, and

wherein the contact elements of different groups are adapted to carry different types of respective signals.

At this point it is noted that it is not possible to determine whether contact elements are adapted to carry different types of respective signals as the claim does not specify whether the contact elements are connected to ground or to a power supply for instance. Furthermore, the claim does not specify geometric differences which could also be possibly seen as a manner of adapting the contact elements for different types of signal. For these reasons, this aspect of the claim can only be interpreted as meaning that the two groups are electrically separated so that they may be used to carry different types of signals.

2.1.3 The technical effect of these differences is not immediately apparent. The applicant has argued that this leads to an overall improvement of the frequency performance of the testing head. However, for instance, if the two groups are directed to a ground group on one hand and a power supply group on the other hand (like possible with the present wording of claim 1) then

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such frequency performance improvement is not necessary occurring, especially also because a grouping of ground connected contact elements is already done.

At present it appears therefore that the grouping of a second group of contact elements is merely directed to an arbitrary design construction which the skilled person would implement according to the circumstances. For instance the second group could be a repetition of the first group used to test in parallel with a second component of the wafer. furthermore many reasons to do such grouping appears to exist some being mentioned on page 2 of D4 with corresponding solutions mentioned on page 8 of D4.

2.1.4 Another manner of assessing the above mentioned difference would be to assume that the second group is directed to a power. In that case an effect of such grouping would be to split the current drawn by the DUT within several paths in order to avoid that too much current is drawn in a probe.

D3 address this problem by using the arrangement shown in Figs. 3 to 6. Fig. 4 discloses the above mentioned distinguishing features , see the conductive portion 50 including holes 40 arranged to house probes 22. The type of signal is here power. It is further referred to paragraphs 0027 to 0030 and 0035 which provide details on these aspects.

The skilled person wishing to solve the above mentioned problem (i.e. reduction of current flowing through a power probe) would get in D3 a teaching that he would incorporate without problem in the testing head of D2, arriving therefore in an obvious manner to the claimed subject-matter.

2.1.5 Lastly, even if one would come to a technical effect linked to the improvement of the frequency performance of the testing head of D2, the mere fact of placing signal routing as near as possible from the DUT (and therefore by doing so de facto creating groups of contact probes) appears to be well known to the skilled person and therefore the subject-matter of claim 1 would also appear from this point of vue not to involve an inventive step either. Again page 8 of D4 appears to provide some teaching on the grouping of probes contacts in the same manner as claimed and as in the present invention.

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2.2 The subject-matter of claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

2.3 At present it appears that none of the claims are patentable as none of these claims would involve an inventive step in view of the cited prior art. For instance claim 2 is rendered obvious by the combination of D2 and D3 as mentioned above or the additional features of claim 20 are already known from D2 (see Fig. 4).

3 All the claims are related to a testing head and therefore the claimed invention is considered to be industrially applicable (Article 33(4) PCT).

Re Item VIII

Certain observations on the application

4 The following claims are not clear (Article 6 PCT).

4.1 Claim 2. The subject-matter of claim 2 relates to the use of the testing head and is therefore not clear. In addition, without having information in the claim on the use of the testing head (for instance which values of power signal are considered) it is not possible to clearly distinguish the contact elements from any prior art or between themselves.

4.2 A similar objection applies to the subject-matter of claim 10.

4.3 Claim 12. It is stated that the body "has a deformation", however it is not stated compared to what or under which circumstances so that this feature is not clear either.

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PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BOTTI & FERRARI S.R.L.
Via Cappellini, 11
I-20124 Milano
ITALIE

PCT

WRITTEN OPINION OF THE INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rule 66)

Date of mailing *(day/month/year)* 21.12.2018

Applicant's or agent's file reference
TEC076BWO

REPLY DUE
within 2 month(s) from the above date of mailing

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2017/082180	11.12.2017	16.12.2016

International Patent Classification (IPC) or both national classification and IPC
INV. G01R1/073

Applicant
Technoprobe S.p.A

1. ☒ The written opinion established by the International Searching Authority:
   ☒ is ☐ is not
   considered to be a written opinion of the International Preliminary Examining Authority.

2. This second opinion contains indications relating to the following items:
   - ☒ Box No. I Basis of the opinion
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☒ Box No. VIII Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.
   When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(e).
   How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 55.3 and 66.8.
   Also: For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4*bis*. For an informal communication with the examiner, see Rule 66.6. For an additional opportunity to submit amendments, see Rule 66.4.

   If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary report on patentability (Chapter II of the PCT) must be established according to Rule 69.2 is: 16.04.2019

Name and mailing address of the international preliminary examining authority:
European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0
Fax: +49 89 2399 - 4465

Authorized Officer
Hijazi, Ali
Telephone No. +49 89 2399-7782

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PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

FERRARI, Barbara
BOTTI & FERRARI S.R.L.
Via Cappellini, 11
I-20124 Milano
ITALIE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	22.03.2019

Applicant's or agent's file reference	**IMPORTANT NOTIFICATION**
TEC076BWO	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2017/082180	11.12.2017	16.12.2016

Applicant
Technoprobe S.p.A

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

   The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

   Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

   For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

   The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:

European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0
Fax: +49 89 2399 - 4465

Authorized Officer

Schubert-Püschel, S

Tel. +49 89 2399-5812

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Box No. I Basis of the report

1. With regard to the **language**, this report is based on

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3(a) and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4(a))
   - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a) and (b))

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-3, 5-32	as originally filed	
4	filed in electronic form on	11-10-2018

Claims, Numbers

1-21	filed in electronic form on	11-10-2018

Drawings, Sheets

1/13-13/13	as originally filed

☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.

3. ☒ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☒ the claims, Nos. 22
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-*bis*)):
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:

5. ☐ This report has been established:
   - ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-*bis*) and 70.2(e)).
   - ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4*bis* and 70.2(e)).

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6. ☒ With regard to top-up searches (Rules 66.1*ter* and 70.2(f)):
   - ☒ A top-up search was carried out by this Authority on 11.12.2018 (all discovered documents are listed in the Supplemental Box Relating to Top-up Search).
     - ☐ Additional relevant documents have been discovered during the top-up search.
   - ☐ No top-up search was carried out by this Authority because it would serve no useful purpose.

7. ☐ Supplementary international search report(s) from Authority(ies) has/have been received and taken into account in establishing this report (Rule 45bis.8(b) and (c)).

* *If item 4 applies, some or all of those sheets may be marked "superseded".*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-21
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-21
Industrial applicability (IA)	Yes:	Claims	1-21
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27)

D2 KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22)

D3 US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17)

D4 WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09)

2 Novelty, inventive step.

2.1 Independent claim 1.

2.1.1 D2 is considered at present as the closest prior art and discloses:

A testing head (Figs. 3, 4) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (11, 12) provided with a plurality of guide holes (11b, 11b', 12b, 12b') and a plurality of contact elements (20) housed in said guide holes, each of said contact elements comprising a body (30) that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one first conductive portion (40a, 40b) that includes the holes of at least one first group of said guide holes and electrically connects (see Fig. 4, corresponding to G connection) a corresponding first group of said contact elements housed in said at least one first group of said guide holes, and

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~~at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,~~

wherein the contact elements of a same (here the first group as defined in D2) group are adapted to carry a same type of signal, and

~~wherein the contact elements of different groups are adapted to carry different types of respective signals.~~

2.1.2 The subject-matter of claim 1 differs from D2 in that the testing head further comprises:

at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,

wherein the contact elements of a same (here the second group) group are adapted to carry a same type of signal, and

wherein the contact elements of different groups are adapted to carry different types of respective signals.

At this point it is noted that it is not possible to determine whether contact elements are adapted to carry different types of respective signals as the claim does not specify whether the contact elements are connected to ground or to a power supply for instance. Furthermore, the claim does not specify geometric differences which could also be possibly seen as a manner of adapting the contact elements for different types of signal. For these reasons, this aspect of the claim can only be interpreted as meaning that the two groups are electrically separated so that they may be used to carry different types of signals.

2.1.3 The technical effect of these differences is not immediately apparent. The applicant has argued that this leads to an overall improvement of the frequency performance of the testing head. However, for instance, if the two groups are directed to a ground group on one hand and a power supply group on the other hand (like possible with the present wording of claim 1) then

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such frequency performance improvement is not necessary occurring, especially also because a grouping of ground connected contact elements is already done.

At present it appears therefore that the grouping of a second group of contact elements is merely directed to an arbitrary design construction which the skilled person would implement according to the circumstances. For instance the second group could be a repetition of the first group used to test in parallel with a second component of the wafer. furthermore many reasons to do such grouping appears to exist some being mentioned on page 2 of D4 with corresponding solutions mentioned on page 8 of D4.

2.1.4 Another manner of assessing the above mentioned difference would be to assume that the second group is directed to a power. In that case an effect of such grouping would be to split the current drawn by the DUT within several paths in order to avoid that too much current is drawn in a probe.

D3 address this problem by using the arrangement shown in Figs. 3 to 6. Fig. 4 discloses the above mentioned distinguishing features , see the conductive portion 50 including holes 40 arranged to house probes 22. The type of signal is here power. It is further referred to paragraphs 0027 to 0030 and 0035 which provide details on these aspects.

The skilled person wishing to solve the above mentioned problem (i.e. reduction of current flowing through a power probe) would get in D3 a teaching that he would incorporate without problem in the testing head of D2, arriving therefore in an obvious manner to the claimed subject-matter.

2.1.5 Lastly, even if one would come to a technical effect linked to the improvement of the frequency performance of the testing head of D2, the mere fact of placing signal routing as near as possible from the DUT (and therefore by doing so de facto creating groups of contact probes) appears to be well known to the skilled person and therefore the subject-matter of claim 1 would also appear from this point of vue not to involve an inventive step either. Again page 8 of D4 appears to provide some teaching on the grouping of probes contacts in the same manner as claimed and as in the present invention.

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2.2 The subject-matter of claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

2.3 At present it appears that none of the claims are patentable as none of these claims would involve an inventive step in view of the cited prior art. For instance claim 2 is rendered obvious by the combination of D2 and D3 as mentioned above or the additional features of claim 20 are already known from D2 (see Fig. 4).

3 All the claims are related to a testing head and therefore the claimed invention is considered to be industrially applicable (Article 33(4) PCT).

Re Item VIII

Certain observations on the application

4 The following claims are not clear (Article 6 PCT).

4.1 Claim 2. The subject-matter of claim 2 relates to the use of the testing head and is therefore not clear. In addition, without having information in the claim on the use of the testing head (for instance which values of power signal are considered) it is not possible to clearly distinguish the contact elements from any prior art or between themselves.

4.2 A similar objection applies to the subject-matter of claim 10.

4.3 Claim 12. It is stated that the body "has a deformation", however it is not stated compared to what or under which circumstances so that this feature is not clear either.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TEC076BWO	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/EP2017/082180	International filing date *(day/month/year)* 11.12.2017	Priority date *(day/month/year)* 16.12.2016

International Patent Classification (IPC) or national classification and IPC
INV. G01R1/073

Applicant
Technoprobe S.p.A

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 11 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions).
      ☐ sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4bis, 70.2(e), 70.16 and 91.2).
      ☐ superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)).
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3*ter* of Annex C of the Administrative Instructions).

4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☒ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
11.10.2018	22.03.2019

Name and mailing address of the international preliminary examining authority:
European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0
Fax: +49 89 2399 - 4465

Authorized officer
Hijazi, Ali
Telephone No. +49 89 2399-7782

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IPR2024-00933

BOTTI & FERRARI

BREVETTI & MARCHI

EUROPEAN PATENT & TRADEMARK ATTORNEYS

MILANO – BOLOGNA – BRESCIA

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EURATTORNEYS

EPO
EUROPEAN PATENT OFFICE
International Preliminary
Examining Authority
D-80298 München
GERMANY

Milano, October 8, 2018

Our ref.: ***TEC076BWO/BF/TS***

Re: Patent Application No. ***PCT/EP2017/082180*** *filed on* 11/12/2017 *and concerning a:* "Testing head having improved frequency properties" *in the name of:* ***TECHNOPROBE S.p.A.***

Dear Sirs,

With reference to the International Search Report and the Written Opinion issued on April 17, 2018 in connection with the above-identified patent application, we wish to submit the following amendments and observations.

1. Amendments

An amended set of claims under Art. 34 PCT is herewith enclosed to be substituted for the claims of the application as originally filed. The new set of claims has been revised in order to better point out and distinctly claim the present invention.

In particular, independent claim 1 has been rephrased to specify that the testing head comprises "a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h, 42h)", *and that the conductive portion* "includes and electrically connects the holes [...] and electrically connects a corresponding group of said contact elements", *as clearly stated throughout the description text of the present application. It is observed that these amendments overcome the clarity objections of Re Item VIII of the Written Opinion.*

Moreover, independent claim 1 has been amended to state that the guide "comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41', 42') of said guide holes (40h,

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41h, 42h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h), wherein the contact elements of a same group are adapted to carry a same type of signal, and wherein the contact elements of different groups are adapted to carry different types of respective signals"*(emphasis added).*

Support for the above amendment can be found in originally filed dependent claim 2, as well as throughout the description text of the present application, where it is clearly and unambiguously disclosed that the contact elements of a same group are adapted to carry a same type of signal (e.g., ground, power or also operative signals), while the contact elements of different groups are adapted to carry a different type of signal.

Originally filed dependent claim 2 has been deleted, while originally filed dependent claims 3-22 have been renumbered as new dependent claims 2-21, the dependencies having been corrected accordingly.

Finally, specification page 4 has been amended in order to acknowledge prior art documents D1 (i.e. US 2012/0242360 A1), D2 (i.e. KR 101 421 051 B1), D3 (i.e. US 2014/0197860 A1), and D4 (i.e. WO 2012/106220 A1).

The annexes include the new set of claims and new specification page 4. Handmarked pages are included for the Examiner's convenience.

2. Observations

In the Written Opinion, the subject-matter of independent claim 1 of the present application is considered as not new in view of the teachings of document D1 (i.e. the aforementioned US patent application n. US 2012/0242360 A1).

The Applicant has duly considered the Examiner's objections and believes that claim 1 as amended is new and inventive over the cited prior art for the following reasons.

Document D1 discloses a probe card wherein the contact probes can be short-circuited by conductive layers (reference 202 or 204 in D1) arranged on a guide. In particular, the probe card of D1 is characterized by an inductive/capacitive coupling between high frequency probes and coupling metal probes, the latter being short-circuited by the above mentioned conductive layers.

However, it is observed that the conductive layers of document D1 are adapted to connect to each other only the coupling probes, i.e. only the probes surrounding the corresponding high-frequency probes, such coupling probes being all identical and no

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distinction between different short-circuited probes being suggested.

On the other hand, the present application provides that there are at least two conductive portions adapted to connect to each other respective different groups of contact probes which are adapted to carry a different type of signal. For example, according to the present patent application, one group can carry ground signals and the other group can carry power signals or also operative signals. This can also imply a physical difference among the short-circuited probes, as stated for example at pages 11 and 12 of the description text of the patent application in re: in case of power contact probes, it is possible to use wires having a larger diameter compared to the diameter of the wires that form the signal probes, as well as it is possible to use also different materials for different contact elements.

Summing up, document D1 does not disclose a first conductive portion and a second conductive portion respectively connecting probes carrying different signals, since clearly there is only one group of probes which is short-circuited.

It is further observed that also the Examiner acknowledges the novelty of the above-indicated feature of the present application, no prior art document disclosing or suggesting a guide equipped with at least two different conductive portions.

From the above considerations, it is thus concluded that the subject matter of independent claim 1 as amended is endowed with the required novelty under Art. 33(2) PCT with respect to document D1.

It is also respectfully remarked that the combination of features of new independent claim 1 has several advantages and that the present application is also inventive.

In particular, the present application provides a way to achieve an overall improvement of the frequency performances of the testing head. Advantageously, it is possible to short-circuit groups of probes without transporting the relative signal to the test equipment, said short-circuit preferably occurring at the lower and/or intermediate guide, i.e. close to the device under test. The different conductive portions represent a plurality of common planes, not only ground/power planes, but also signal planes. In the former cases, the common planes reduce inductance loops; in the latter case, the electrical connection between contact elements that carry operating signals improves the performances when there is a need to electrically connect two or more contact pads of the device under test, for example in the loop-back technique.

In document D1 there is no suggestion of short-circuiting different groups of probes by means of different conductive portions as instead provided in the present application. In fact, D1 discloses the presence of conductive portions for connecting only the coupling probes, with a different purpose than the patent application re.

Summing up, when faced with the technical problem of the present application, the

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skilled man would not have found any hint in D1 that would have prompted him to modify the card disclosed therein to obtain the solution of the present application.

In light of the above remarks, it is believed that the subject-matter of claim 1 is endowed with the required inventive step under Art. 33(3) PCT over document D1.

In the Written Opinion, the subject-matter of independent claim 1 of the present application is also considered as not new in view of the teachings of documents D2 (i.e. KR 101 421 051 B1), D3 (i.e. US 2014/0197860 A1) and D4 (i.e. WO 2012/106220 A1).

The Applicant respectfully remarks that the above indicated features of new independent claim 1, which distinguish it over document D1, are not disclosed nor suggested in documents D2-D4 either and that, starting from document D1, the skilled man would have not found in documents D2-D4 any teaching allowing him to fill the many differences between D1 and the patent application in re.

In particular, document D2 relates to a testing head wherein the guide holes of the guide comprise a metal portion in contact with the end portions of the contact probes. The Applicant points out that the metal portions of D2 are far from the conductive portions as claimed in the present application: the metal portions of D2 are clearly not intended to electrically connect different groups of probes that carry respective different types of signals, e.g. ground signals or power signals, as instead claimed in the present application.

Document D3 relates to a testing head comprising a guide equipped with a current-diverting circuit to which all the probes are connected. The current-diverting circuit of D3 comprises traces divided into primary branches (reference 52) and secondary branches (reference 54). Clearly, these branches are very far from the conductive portions of the present application, since all the probes of D3 are indistinctly connected to the diverting circuit and there is no mention of different contact probes carrying different types of signals.

Finally, document D4 discloses a socked for an integrated circuit allowing the setting of a plurality of power sources or grounds. It is observed that the socket of D4 is not comparable to a testing head comprising a guide adapted to house a plurality of contact probes, as instead claimed in the patent application in re. Therefore, although D4 shows different conductive layers, it discloses a socket having a completely different structure form the testing head of the present application. It is also observed that the layers of D4 are not used to improve the frequency performances of the system, as instead provided in the present application. Therefore, the skilled man, facing the problem tied to the frequency performances, would not consider D4 in order to obtain the invention disclosed in the present application.

In the light of the above remarks, it is thus believed that the subject-matter of

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independent claim 1 and of the claims depending thereon is endowed with the required novelty under Art. 33(2) PCT and with the required inventive step under Art. 33(3) PCT over documents D1-D4, taken alone or in combination.

*** ** * ** ***

In view of the amendments as filed and for all the above reasons, a positive international preliminary examination report established on the basis of here-enclosed new claims is expected.

In case there might remain any outstanding issues, we kindly ask the Examiner to timely issue an additional Written Opinion pursuant to Rule 66.4 PCT, before issuing the IPRP.

Many thanks and best regards.

Yours Sincerely,
The Representative
Barbara Ferrari

Encl.: new set of claims;
new specification page 4; and
handmarked pages

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In the case of a testing head of the kind described above, it is well known that the presence of several contact elements adapted to carry ground signals, as well as the presence of contact elements adapted to carry power signals, creates interferences, therefore causing noise in the input/output signals used for the test of the device under test, which limits the frequency performance of the testing head. In the case of contact elements adapted to carry ground signals, disadvantageous ground loops may also occur.

The possible necessity of shorting two or more contact pads of the device under test is also known. According to a known solution, known in the field as "loop-back", it is possible to short two contact pads of the device under test by means of the contact probes of the testing head, wherein a first probe carries a signal from a first pad of the device under test towards the test equipment and then the signal is closed on a second pad of the device under test by means of a second contact probe which contacts said second pad. In this case, however, the long path of the signal from the device under test to the test equipment and vice versa causes a reduction of the frequency performance of the testing head.

Conductive structures adapted to electrically connect contact probes to each other are disclosed for example in US 2012/0242360 A1, KR 101 421 051 B1, US 2014/0197860 A1, and WO 2012/106220 A1.

However, the need to improve the frequency performances of a testing head is strongly felt in this technical field.

The technical problem of the present invention is to provide a testing head having structural and functional features such as to allow overcoming the limitations and drawbacks still affecting the known solutions, in particular able to reduce a simple way (and to eliminate in a simple way too) the interferences, and therefore the noise, caused by the presence of ground and power contact elements, as well as able to allow an electrical connection between contact pads of a device under test without reducing the frequency performances of the testing head itself.

Summary of the invention

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TEC076BWO

CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h), and a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h, 42h), each of said contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), said testing head (20) being characterized in that said at least one guide (40, 41, 42) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h), wherein the contact elements of a same group are adapted to carry a same type of signal, and wherein the contact elements of different groups are adapted to carry different types of respective signals.

2. The testing head (20) according to claim 1, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

3. The testing head (20) according to claim 1 or 2, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41, 42), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41, 42).

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4. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

5. The testing head (20) according to claim 4, characterized in that said at least one guide (40, 41, 42) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

6. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

7. The testing head (20) according to any one of the claims from 1 to 5, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"),

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said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

8. The testing head (20) according to claim 6 or 7, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

9. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30'") that includes and electrically connects the holes of a third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, said third group (40'", 41'", 42'") housing third contact elements (21'").

10. The testing head (20) according to claim 9, characterized in that said third contact elements (21'") housed in said third group (40'", 41'", 42'") of said guide holes (40h, 41h, 42h) are adapted to carry input/output signals between the device under test and a test equipment.

11. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") covers at least one portion (40'W, 40"W , 40'"W; 41'W, 41"W, 41'"W) of an inner surface of each guide hole of said group (40', 40", 40'"; 41', 41", 41'") of said guide holes (40h, 41h).

12. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21'") are contact probes wherein said body (21pr) has a deformation.

13. The testing head (20) according to any one of the claims from 1 to 5, characterized in that said contact elements (21', 21", 21'") are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1)

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and a second surface (S2), at least one of said surfaces (S1, S2) being apt to abut onto said at least one guide (40, 42), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said first and/or second surface (S1, S2).

14. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42).

16. The testing head (20) according to any one of the claims from 1 to 14, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41, 42), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") are formed.

17. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h, 42h) apt to house a single contact element, said at least one guide (40, 41, 42) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive

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portion (30bis) to other conductive portions.

18. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41, 42).

19. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') comprises a plurality of conductive portions overlapped to and electrically insulated from each other.

20. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h, 42h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21"'), said contact elements included in said respective groups being adapted to carry a same type of signal.

21. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41, 42).

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ITALIE

Date: 26.04.19

Reference	Application No./Patent No.
	17825770.5 - 1022 PCT/EP2017082180
Applicant/Proprietor	
Technoprobe S.p.A	

Entry into the European phase before the European Patent Office

The following information describes the procedural steps required for entry into the European phase before the European Patent Office (EPO) as designated/elected Office. You are advised to read it carefully because failure to take the necessary action in due time can lead to a loss of rights.

1. The above mentioned international patent application has been given the **European application No. 17825770.5**. This application number is to be used in correspondence with the EPO.

2. Applicants **without a residence or their principal place of business** in an EPC Contracting State may themselves initiate European processing of their international applications, provided they do so before expiry of the 31st month from the priority date.

   During the European phase before the EPO as designated or elected Office, however, such applicants **must** be represented by a professional representative (Art. 133(2) and Art. 134(1) and (8) EPC).

   Where, at the expiry of the time period laid down in Rule 163(5) EPC, the requirements of Article 133(2) EPC have not been complied with, the European patent application will be **refused**, pursuant to Rule 163(6) EPC.

   Please note that a professional representative authorised to act before the EPO and who acted for the applicant during the international phase does not automatically become the representative for the European phase. Applicants are therefore strongly advised to appoint in good time any representative they wish to initiate the European phase for them; otherwise the EPO has to send all communications directly to the applicant.

3. Applicants **with a residence or their principal place of business** in an EPC Contracting State are not obliged to appoint for the European phase a professional representative authorised to act before the EPO. However, in view of the complexity of the procedure it is recommended that they do so.

4. Applicants and professional representatives are also strongly advised to initiate the European phase using **EPO Form 1200**. It is available free of charge from the EPO or via the EPO website at **www.epo.org**. Similarly, it can be generated using the Online Filing software, obtainable free of charge from the EPO, or the new online filing (CMS). The use of the form is not compulsory.

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5. Applicants wishing to use an address for correspondence which is different from the address of their seat or residence are advised to indicate this address in section 1 of EPO Form 1200. When acting as designated or elected Office, the EPO will accept an address for correspondence only if no professional representative must be or is appointed (Art. 133 and 134 EPC). This address must be the applicant's own address and must be located in an EPC Contracting State. Any address for correspondence accepted for the procedure in the international phase which does not fulfil those conditions will not be accepted in the procedure before the EPO in the European phase.

6. To enter the European phase before the EPO as designated or elected Office (Art. 22(1) and (3) and 39(1) PCT), the **following acts** must be performed by the applicant within **31 months** from the date of filing of the international application or (where applicable) the earliest priority date:

   a) Supply a translation of the international application into an EPO official language, if the International Bureau did not publish the application in such language (Art. 22(1) PCT and R. 159(1)(a) EPC);

   b) Specify the application documents, as originally filed or as amended, on which the European grant procedure is to be based (R. 159(1)(b) EPC);

   c) Pay the filing fee and, where applicable, the additional fee for a European patent application comprising more than 35 pages (R. 159(1)(c) EPC, Art. 2(1), items 1, 1a Rules relating to Fees (RFees));

   d) Pay the search fee where a supplementary European search report has to be drawn up (R. 159(1)(e) EPC);

   e) Pay the designation fee if the time limit laid down in Rule 39(1) EPC (i.e. six months after publication of the international search report) has expired before the 31-month period pursuant to Rule 159(1) EPC (R. 159(1)(d) EPC);

   f) File the written request for examination and pay the examination fee if the time limit laid down in Rule 70(1) EPC has expired before the 31-month period pursuant to Rule 159(1) EPC (R. 159(1)(f) EPC);

   g) Pay the renewal fee in respect of the third year, if the fee has fallen due (see Rule 51(1) EPC) before expiry of the 31-month period pursuant to Rule 159(1) EPC (R. 159(1)(g) EPC);

   h) File, where applicable, the certificate of exhibition referred to in Article 55(2) and Rule 25 EPC (R. 159(1)(h) EPC);

   i) Pay the claims fees for the sixteenth and each subsequent claim when the application documents on which the European grant procedure is to be based comprise more than fifteen claims (R. 162(1) EPC). A higher amount is payable for the 51st and each subsequent claim (Art.2(1), item 15 RFees).

   If either the translation of the international application or the request for examination is not filed in time, or if the filing fee, the additional fee, the search fee, the designation fee or the examination fee is not paid in due time, the application shall be deemed to be withdrawn (R. 160(1) EPC).

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7. Making payments

For payments made via deposit account, please note that as from 1 December 2017 debit orders will only be carried out if filed in an electronically processable format (xml), using an accepted means of filing as laid down in the Arrangements for deposit accounts (ADA), published in a Supplementary publication to the Official Journal.

All relevant information related to the modes of payment of fees to the EPO can be retrieved from the EPO website at "**Making Payments**".

Information concerning fee amounts
Procedural fees are usually adjusted every two years, on even years, with effect from 1 April. Therefore, before making a payment, parties should verify the amounts actually due on the date of payment using the applicable version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, available on the EPO website (**www.epo.org**) at **www.epo.org/schedule-of-fees**. The "Schedule of fees" table allows the viewing, downloading and searching of individual fee amounts, both current and previous.

8. Restoration of priority right

Where the international application contains a priority claim to an earlier application and it has been filed within two months from the expiration of the 12-month priority period, a request for restoration before the EPO as designated Office (R. 49*ter*.2 PCT) applies under the following circumstances:

a) No request for restoration filed before the receiving Office (RO) during the international phase (R. 26*bis*.3 PCT)
b) Negative decision by the RO irrespective of the criterion applied (due care/unintentionality)
c) Positive decision by the RO based on the unintentionality criterion.

For a request to be admissible, it must be filed and the requisite fee must be paid (R. 49*ter*.2(b)(iii) and R. 49*ter*.2(d) PCT, Art.2(1), item 13 RFees) within the one-month time limit under R. 49*ter*.2(b)(i) PCT for filing the request, which starts from the expiry of the 31-month time limit pursuant to Rule 159(1)EPC and Article 22(3) or 39(1)(b) PCT or, where applicable, from the date on which an effective request for early processing (Art. 23(2) or 40(2) PCT) is filed ('Notice from the European Patent Office dated 21 February 2013 concerning the request for early processing', OJ EPO 2013, 158). The request for restoration also needs to state the reasons for the failure to file the international application within the priority period (Rule 49*ter*.2(b)(ii) PCT).

9. If the applicant had appointed a representative during the application's international phase, the present Form will be sent to the representative, asking him to inform the applicant accordingly.
All subsequent communications will be sent to the applicant, or - if the EPO is informed of his appointment in time - to the applicant's European representative.

10. For more details about time limits and procedural acts before the EPO as designated or elected Office, see the EPO brochure Euro-PCT Guide: PCT procedure at the EPO. This brochure, the list of professional representatives before the EPO, Form 1200 and details of the latest fees are available on the EPO website **(www.epo.org)**.

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11. **Programme for accelerated prosecution of European patent applications - "PACE"**

Applicants wishing to accelerate proceedings before the EPO as designated or elected Office may request accelerated prosecution under the PACE programme (Notice from the European Patent Office dated 30 November 2015 concerning the programme for accelerated prosecution of European patent applications - "PACE", OJ EPO 2015, A93).

Receiving Section



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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TEC076BWO	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/EP2017/082180	International filing date *(day/month/year)* 11.12.2017	Priority date *(day/month/year)* 16.12.2016

International Patent Classification (IPC) or national classification and IPC
INV. G01R1/073

Applicant
Technoprobe S.p.A

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 11 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions).
      ☐ sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4bis, 70.2(e), 70.16 and 91.2).
      ☐ superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)).
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3*ter* of Annex C of the Administrative Instructions).

4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☒ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
11.10.2018	22.03.2019

Name and mailing address of the international preliminary examining authority:

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D-80298 Munich
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Box No. I Basis of the report

1. With regard to the **language**, this report is based on

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3(a) and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4(a))
   - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a) and (b))

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-3, 5-32	as originally filed	
4	filed in electronic form on	11-10-2018

Claims, Numbers

1-21	filed in electronic form on	11-10-2018

Drawings, Sheets

1/13-13/13	as originally filed

☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.

3. ☒ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☒ the claims, Nos. 22
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-*bis*)):
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:

5. ☐ This report has been established:
   - ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-*bis*) and 70.2(e)).
   - ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4*bis* and 70.2(e)).

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6. ☒ With regard to top-up searches (Rules 66.1*ter* and 70.2(f)):
   - ☒ A top-up search was carried out by this Authority on 11.12.2018 (all discovered documents are listed in the Supplemental Box Relating to Top-up Search).
     - ☐ Additional relevant documents have been discovered during the top-up search.
   - ☐ No top-up search was carried out by this Authority because it would serve no useful purpose.

7. ☐ Supplementary international search report(s) from Authority(ies) has/have been received and taken into account in establishing this report (Rule 45bis.8(b) and (c)).

* *If item 4 applies, some or all of those sheets may be marked "superseded".*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-21
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-21
Industrial applicability (IA)	Yes:	Claims	1-21
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27)

D2 KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22)

D3 US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17)

D4 WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09)

2 Novelty, inventive step.

2.1 Independent claim 1.

2.1.1 D2 is considered at present as the closest prior art and discloses:

A testing head (Figs. 3, 4) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (11, 12) provided with a plurality of guide holes (11b, 11b', 12b, 12b') and a plurality of contact elements (20) housed in said guide holes, each of said contact elements comprising a body (30) that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one first conductive portion (40a, 40b) that includes the holes of at least one first group of said guide holes and electrically connects (see Fig. 4, corresponding to G connection) a corresponding first group of said contact elements housed in said at least one first group of said guide holes, and

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~~at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,~~

wherein the contact elements of a same (here the first group as defined in D2) group are adapted to carry a same type of signal, and

~~wherein the contact elements of different groups are adapted to carry different types of respective signals.~~

2.1.2 The subject-matter of claim 1 differs from D2 in that the testing head further comprises:

at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,

wherein the contact elements of a same (here the second group) group are adapted to carry a same type of signal, and

wherein the contact elements of different groups are adapted to carry different types of respective signals.

At this point it is noted that it is not possible to determine whether contact elements are adapted to carry different types of respective signals as the claim does not specify whether the contact elements are connected to ground or to a power supply for instance. Furthermore, the claim does not specify geometric differences which could also be possibly seen as a manner of adapting the contact elements for different types of signal. For these reasons, this aspect of the claim can only be interpreted as meaning that the two groups are electrically separated so that they may be used to carry different types of signals.

2.1.3 The technical effect of these differences is not immediately apparent. The applicant has argued that this leads to an overall improvement of the frequency performance of the testing head. However, for instance, if the two groups are directed to a ground group on one hand and a power supply group on the other hand (like possible with the present wording of claim 1) then

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such frequency performance improvement is not necessary occurring, especially also because a grouping of ground connected contact elements is already done.

At present it appears therefore that the grouping of a second group of contact elements is merely directed to an arbitrary design construction which the skilled person would implement according to the circumstances. For instance the second group could be a repetition of the first group used to test in parallel with a second component of the wafer. furthermore many reasons to do such grouping appears to exist some being mentioned on page 2 of D4 with corresponding solutions mentioned on page 8 of D4.

2.1.4 Another manner of assessing the above mentioned difference would be to assume that the second group is directed to a power. In that case an effect of such grouping would be to split the current drawn by the DUT within several paths in order to avoid that too much current is drawn in a probe.

D3 address this problem by using the arrangement shown in Figs. 3 to 6. Fig. 4 discloses the above mentioned distinguishing features , see the conductive portion 50 including holes 40 arranged to house probes 22. The type of signal is here power. It is further referred to paragraphs 0027 to 0030 and 0035 which provide details on these aspects.

The skilled person wishing to solve the above mentioned problem (i.e. reduction of current flowing through a power probe) would get in D3 a teaching that he would incorporate without problem in the testing head of D2, arriving therefore in an obvious manner to the claimed subject-matter.

2.1.5 Lastly, even if one would come to a technical effect linked to the improvement of the frequency performance of the testing head of D2, the mere fact of placing signal routing as near as possible from the DUT (and therefore by doing so de facto creating groups of contact probes) appears to be well known to the skilled person and therefore the subject-matter of claim 1 would also appear from this point of vue not to involve an inventive step either. Again page 8 of D4 appears to provide some teaching on the grouping of probes contacts in the same manner as claimed and as in the present invention.

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2.2 The subject-matter of claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

2.3 At present it appears that none of the claims are patentable as none of these claims would involve an inventive step in view of the cited prior art. For instance claim 2 is rendered obvious by the combination of D2 and D3 as mentioned above or the additional features of claim 20 are already known from D2 (see Fig. 4).

3 All the claims are related to a testing head and therefore the claimed invention is considered to be industrially applicable (Article 33(4) PCT).

Re Item VIII

Certain observations on the application

4 The following claims are not clear (Article 6 PCT).

4.1 Claim 2. The subject-matter of claim 2 relates to the use of the testing head and is therefore not clear. In addition, without having information in the claim on the use of the testing head (for instance which values of power signal are considered) it is not possible to clearly distinguish the contact elements from any prior art or between themselves.

4.2 A similar objection applies to the subject-matter of claim 10.

4.3 Claim 12. It is stated that the body "has a deformation", however it is not stated compared to what or under which circumstances so that this feature is not clear either.

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Milano, October 8, 2018

Our ref.: ***TEC076BWO/BF/TS***

Re: Patent Application No. ***PCT/EP2017/082180*** *filed on* 11/12/2017 *and concerning a:* "Testing head having improved frequency properties" *in the name of:* ***TECHNOPROBE S.p.A.***

Dear Sirs,

With reference to the International Search Report and the Written Opinion issued on April 17, 2018 in connection with the above-identified patent application, we wish to submit the following amendments and observations.

1. Amendments

An amended set of claims under Art. 34 PCT is herewith enclosed to be substituted for the claims of the application as originally filed. The new set of claims has been revised in order to better point out and distinctly claim the present invention.

In particular, independent claim 1 has been rephrased to specify that the testing head comprises "a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h, 42h)", *and that the conductive portion* "includes and electrically connects the holes [...] and electrically connects a corresponding group of said contact elements", *as clearly stated throughout the description text of the present application. It is observed that these amendments overcome the clarity objections of Re Item VIII of the Written Opinion.*

Moreover, independent claim 1 has been amended to state that the guide "comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41', 42') of said guide holes (40h,

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41h, 42h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h), wherein the contact elements of a same group are adapted to carry a same type of signal, and wherein the contact elements of different groups are adapted to carry different types of respective signals"*(emphasis added).*

Support for the above amendment can be found in originally filed dependent claim 2, as well as throughout the description text of the present application, where it is clearly and unambiguously disclosed that the contact elements of a same group are adapted to carry a same type of signal (e.g., ground, power or also operative signals), while the contact elements of different groups are adapted to carry a different type of signal.

Originally filed dependent claim 2 has been deleted, while originally filed dependent claims 3-22 have been renumbered as new dependent claims 2-21, the dependencies having been corrected accordingly.

Finally, specification page 4 has been amended in order to acknowledge prior art documents D1 (i.e. US 2012/0242360 A1), D2 (i.e. KR 101 421 051 B1), D3 (i.e. US 2014/0197860 A1), and D4 (i.e. WO 2012/106220 A1).

The annexes include the new set of claims and new specification page 4. Handmarked pages are included for the Examiner's convenience.

2. Observations

In the Written Opinion, the subject-matter of independent claim 1 of the present application is considered as not new in view of the teachings of document D1 (i.e. the aforementioned US patent application n. US 2012/0242360 A1).

The Applicant has duly considered the Examiner's objections and believes that claim 1 as amended is new and inventive over the cited prior art for the following reasons.

Document D1 discloses a probe card wherein the contact probes can be short-circuited by conductive layers (reference 202 or 204 in D1) arranged on a guide. In particular, the probe card of D1 is characterized by an inductive/capacitive coupling between high frequency probes and coupling metal probes, the latter being short-circuited by the above mentioned conductive layers.

However, it is observed that the conductive layers of document D1 are adapted to connect to each other only the coupling probes, i.e. only the probes surrounding the corresponding high-frequency probes, such coupling probes being all identical and no

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distinction between different short-circuited probes being suggested.

On the other hand, the present application provides that there are at least two conductive portions adapted to connect to each other respective different groups of contact probes which are adapted to carry a different type of signal. For example, according to the present patent application, one group can carry ground signals and the other group can carry power signals or also operative signals. This can also imply a physical difference among the short-circuited probes, as stated for example at pages 11 and 12 of the description text of the patent application in re: in case of power contact probes, it is possible to use wires having a larger diameter compared to the diameter of the wires that form the signal probes, as well as it is possible to use also different materials for different contact elements.

Summing up, document D1 does not disclose a first conductive portion and a second conductive portion respectively connecting probes carrying different signals, since clearly there is only one group of probes which is short-circuited.

It is further observed that also the Examiner acknowledges the novelty of the above-indicated feature of the present application, no prior art document disclosing or suggesting a guide equipped with at least two different conductive portions.

From the above considerations, it is thus concluded that the subject matter of independent claim 1 as amended is endowed with the required novelty under Art. 33(2) PCT with respect to document D1.

It is also respectfully remarked that the combination of features of new independent claim 1 has several advantages and that the present application is also inventive.

In particular, the present application provides a way to achieve an overall improvement of the frequency performances of the testing head. Advantageously, it is possible to short-circuit groups of probes without transporting the relative signal to the test equipment, said short-circuit preferably occurring at the lower and/or intermediate guide, i.e. close to the device under test. The different conductive portions represent a plurality of common planes, not only ground/power planes, but also signal planes. In the former cases, the common planes reduce inductance loops; in the latter case, the electrical connection between contact elements that carry operating signals improves the performances when there is a need to electrically connect two or more contact pads of the device under test, for example in the loop-back technique.

In document D1 there is no suggestion of short-circuiting different groups of probes by means of different conductive portions as instead provided in the present application. In fact, D1 discloses the presence of conductive portions for connecting only the coupling probes, with a different purpose than the patent application re.

Summing up, when faced with the technical problem of the present application, the

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skilled man would not have found any hint in D1 that would have prompted him to modify the card disclosed therein to obtain the solution of the present application.

In light of the above remarks, it is believed that the subject-matter of claim 1 is endowed with the required inventive step under Art. 33(3) PCT over document D1.

In the Written Opinion, the subject-matter of independent claim 1 of the present application is also considered as not new in view of the teachings of documents D2 (i.e. KR 101 421 051 B1), D3 (i.e. US 2014/0197860 A1) and D4 (i.e. WO 2012/106220 A1).

The Applicant respectfully remarks that the above indicated features of new independent claim 1, which distinguish it over document D1, are not disclosed nor suggested in documents D2-D4 either and that, starting from document D1, the skilled man would have not found in documents D2-D4 any teaching allowing him to fill the many differences between D1 and the patent application in re.

In particular, document D2 relates to a testing head wherein the guide holes of the guide comprise a metal portion in contact with the end portions of the contact probes. The Applicant points out that the metal portions of D2 are far from the conductive portions as claimed in the present application: the metal portions of D2 are clearly not intended to electrically connect different groups of probes that carry respective different types of signals, e.g. ground signals or power signals, as instead claimed in the present application.

Document D3 relates to a testing head comprising a guide equipped with a current-diverting circuit to which all the probes are connected. The current-diverting circuit of D3 comprises traces divided into primary branches (reference 52) and secondary branches (reference 54). Clearly, these branches are very far from the conductive portions of the present application, since all the probes of D3 are indistinctly connected to the diverting circuit and there is no mention of different contact probes carrying different types of signals.

Finally, document D4 discloses a socked for an integrated circuit allowing the setting of a plurality of power sources or grounds. It is observed that the socket of D4 is not comparable to a testing head comprising a guide adapted to house a plurality of contact probes, as instead claimed in the patent application in re. Therefore, although D4 shows different conductive layers, it discloses a socket having a completely different structure form the testing head of the present application. It is also observed that the layers of D4 are not used to improve the frequency performances of the system, as instead provided in the present application. Therefore, the skilled man, facing the problem tied to the frequency performances, would not consider D4 in order to obtain the invention disclosed in the present application.

In the light of the above remarks, it is thus believed that the subject-matter of

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independent claim 1 and of the claims depending thereon is endowed with the required novelty under Art. 33(2) PCT and with the required inventive step under Art. 33(3) PCT over documents D1-D4, taken alone or in combination.

*** ** * ** ***

In view of the amendments as filed and for all the above reasons, a positive international preliminary examination report established on the basis of here-enclosed new claims is expected.

In case there might remain any outstanding issues, we kindly ask the Examiner to timely issue an additional Written Opinion pursuant to Rule 66.4 PCT, before issuing the IPRP.

Many thanks and best regards.

Yours Sincerely,
The Representative
Barbara Ferrari

Encl.: new set of claims;
new specification page 4; and
handmarked pages

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In the case of a testing head of the kind described above, it is well known that the presence of several contact elements adapted to carry ground signals, as well as the presence of contact elements adapted to carry power signals, creates interferences, therefore causing noise in the input/output signals used for the test of the device under test, which limits the frequency performance of the testing head. In the case of contact elements adapted to carry ground signals, disadvantageous ground loops may also occur.

The possible necessity of shorting two or more contact pads of the device under test is also known. According to a known solution, known in the field as "loop-back", it is possible to short two contact pads of the device under test by means of the contact probes of the testing head, wherein a first probe carries a signal from a first pad of the device under test towards the test equipment and then the signal is closed on a second pad of the device under test by means of a second contact probe which contacts said second pad. In this case, however, the long path of the signal from the device under test to the test equipment and vice versa causes a reduction of the frequency performance of the testing head.

Conductive structures adapted to electrically connect contact probes to each other are disclosed for example in US 2012/0242360 A1, KR 101 421 051 B1, US 2014/0197860 A1, and WO 2012/106220 A1.

However, the need to improve the frequency performances of a testing head is strongly felt in this technical field.

The technical problem of the present invention is to provide a testing head having structural and functional features such as to allow overcoming the limitations and drawbacks still affecting the known solutions, in particular able to reduce a simple way (and to eliminate in a simple way too) the interferences, and therefore the noise, caused by the presence of ground and power contact elements, as well as able to allow an electrical connection between contact pads of a device under test without reducing the frequency performances of the testing head itself.

Summary of the invention

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TEC076BWO

CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41, 42) provided with a plurality of guide holes (40h, 41h, 42h), and a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h, 42h), each of said contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), said testing head (20) being characterized in that said at least one guide (40, 41, 42) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41', 42') of said guide holes (40h, 41h, 42h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41", 42") of said guide holes (40h, 41h, 42h), wherein the contact elements of a same group are adapted to carry a same type of signal, and wherein the contact elements of different groups are adapted to carry different types of respective signals.

2. The testing head (20) according to claim 1, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

3. The testing head (20) according to claim 1 or 2, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41, 42), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41, 42).

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4. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

5. The testing head (20) according to claim 4, characterized in that said at least one guide (40, 41, 42) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

6. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

7. The testing head (20) according to any one of the claims from 1 to 5, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"),

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said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

8. The testing head (20) according to claim 6 or 7, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.

9. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30"') that includes and electrically connects the holes of a third group (40"', 41"', 42"') of said guide holes (40h, 41h, 42h) to each other, said third group (40"', 41"', 42"') housing third contact elements (21"').

10. The testing head (20) according to claim 9, characterized in that said third contact elements (21"') housed in said third group (40"', 41"', 42"') of said guide holes (40h, 41h, 42h) are adapted to carry input/output signals between the device under test and a test equipment.

11. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') covers at least one portion (40'W, 40"W , 40"'W; 41'W, 41"W, 41"'W) of an inner surface of each guide hole of said group (40', 40", 40"'; 41', 41", 41"') of said guide holes (40h, 41h).

12. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21"') are contact probes wherein said body (21pr) has a deformation.

13. The testing head (20) according to any one of the claims from 1 to 5, characterized in that said contact elements (21', 21", 21"') are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1)

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and a second surface (S2), at least one of said surfaces (S1, S2) being apt to abut onto said at least one guide (40, 42), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said first and/or second surface (S1, S2).

14. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41, 42).

16. The testing head (20) according to any one of the claims from 1 to 14, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41, 42), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") of said guide holes (40h, 41h, 42h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41', 42'; 40", 41", 42"; 40'", 41'", 42'") are formed.

17. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, 42) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h, 42h) apt to house a single contact element, said at least one guide (40, 41, 42) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive

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portion (30bis) to other conductive portions.

18. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41, 42).

19. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') comprises a plurality of conductive portions overlapped to and electrically insulated from each other.

20. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h, 42h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21"'), said contact elements included in said respective groups being adapted to carry a same type of signal.

21. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41, 42).

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Europäisches Patentamt
European Patent Office
Office européen des brevets

Entry into the European phase (EPO as designated or elected Office)

To the European Patent Office

European application number	EP17825770.5
PCT application number	PCT/EP2017/082180
PCT publication number	WO2018108790
Applicant's or representative's reference	TEC076WEP
International Filing Date	11.12.2017
International Searching Authority (ISA)	EP
International Preliminary Examining Authority (IPEA)	EP

1. Applicant

Indications concerning the applicant(s) are contained in the international publication or were recorded by the International Bureau after the international publication. ☒

Changes which have not yet been recorded by the International Bureau are set out here: ☐

2. Representative

Representative 1

Representative or association of representatives to be listed in the Register of European Patents and to whom communications are to be notified

Name: FERRARI Barbara

Company: BOTTI & FERRARI S.r.l.

Address of place of business: Via Cappellini, 11
20124 Milano,
Italy

Telephone: + 39 02 67 04 275

Fax: + 39 02 67 03 250

3. Authorisation

Representative 1

An individual authorisation is attached. ☐

A general authorisation has been registered under No: ☐

A general authorisation has been filed, but not yet registered. ☐

The authorisation filed with the EPO as PCT receiving Office expressly includes the European phase. ☐

4. Request for examination

Examination of the application under Art. 94 EPC is hereby requested. The examination fee is being (has been, will be) paid. ☒

Request for examination in an admissible non-EPO language: ☐

The/Each applicant hereby declares that he is an entity or a natural person under Rule 6(4) EPC. ☐

5. Copies

Additional copies of the documents cited in the supplementary European search report are requested. ☐

Number of additional sets of copies

6. Documents intended for proceedings before the EPO

Number of claims on entry into the European phase: 21

6.1 Proceedings before the EPO as designated Office (PCT I) are to be based on the following documents

the application documents published by the International Bureau; where the publication includes a set of claims amended under Article 19 PCT, the latter replaces the originally filed claims ☐

unless replaced by the amendments attached. ☐

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comments on the written opinion established by the EPO as the International Searching Authority and/or observations or, where applicable, on the explanations given in the Supplementary International Search Report established by the EPO as the Supplementary International Searching Authority (Rule 45bis.7(e) PCT)	☐
Where necessary, further details should be attached as "Other documents"	
6.2 Proceedings before the EPO as elected Office (PCT II) are to be based on the following documents:	
the documents on which the international preliminary examination report is based, including any annexes	☒
unless replaced by the amendments attached.	☐
comments on the international preliminary examination report established by the EPO as the International Preliminary Examining Authority and/or observations are enclosed.	☐
Where necessary, further details should be attached as "Other documents"	
If the EPO as International Preliminary Examining Authority has been supplied with test reports, these may be used as the basis of proceedings before the EPO.	☒
6.3 A copy of the results of the search carried out by the authority with which the previous application(s) whose priority is claimed was (were) filed is attached (R. 141(1) EPC).	☐
7. Translations	
Translations in one of the official languages of the EPO (English, French, German) are attached as crossed below:	☐
** In proceedings before the EPO as designated or elected Office (PCT I + II):*	
7.1 Translation of the international application (description, claims, any text in the drawings) as originally filed, of the abstract as published and of any indication under Rule 13bis.3 and 13bis.4 PCT regarding biological material	☐
7.2 Translation of the priority application(s) (to be filed only at the EPO's request, Rule 53(3) EPC)	☐
7.3 It is hereby declared that the international application as originally filed is a complete translation of the previous application (Rule 53(3) EPC)	☐
** In addition, in proceedings before the EPO as designated Office (PCT I):*	
7.4 Translation of amended claims and any statement under Art. 19 PCT, if the claims as amended are to form the basis for the proceedings before the EPO (see Section 6).	☐
** In addition, in proceedings before the EPO as elected Office (PCT II):*	
7.5 Translation of any annexes to the international preliminary examination report	☐
8. Biological material	
The invention uses and/or relates to biological material deposited under Rule 31 EPC.	☐
The particulars referred to in Rule 31(1)(c) EPC (if not yet known, the depositary institution and the identification reference(s)) [number, symbols, etc.] of the depositor) are given in the international publication or in the translation submitted in Section 7 on:	☐
page(s) / line(s)	
The receipt(s) of deposit issued by the depositary institution	
is (are) enclosed.	☐
will be filed later.	☐
Waiver of the right to an undertaking from the requester pursuant to Rule 33(2) EPC attached.	☐
9. Nucleotide and amino acid sequences	
The international application discloses nucleotide and/or amino acid sequences.	☐
9.1 The sequence listing was filed under Rule 5.2(a) PCT, or furnished to the EPO as ISA under Rule 13ter.1(a) PCT, or is otherwise available to the EPO, in computer-readable format in accordance with WIPO ST.25.	☐
9.2	
The sequence listing is attached in computer-readable format in accordance with WIPO Standard ST.25 (Rule 163(3) EPC)	☐

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The sequence listing does not include matter which goes beyond the content of the application as filed.	☐

10. Designation of contracting states

All the contracting states party to the EPC at the time of filing of the international patent application and designated in the international application are deemed to be designated (see Article 79(1) EPC).	☒

11. Extension/Validation

This application is deemed to be a request to extend the effects of the European patent application and the European patent granted in respect of it to all non-contracting states to the EPC designated in the international application with which extension or validation agreements were in force on the date on which the application was filed. However, the request is deemed withdrawn if the extension fee or the validation fee, whichever is applicable, is not paid within the prescribed time limit.	☐
11.1 It is intended to pay the extension fee(s) for the following state(s):	
11.2 It is intended to pay the validation fee(s) for the following state(s):	
Note: Under the automatic debiting procedure, extension and/or validation fees will be debited only for states indicated here unless the EPO is instructed otherwise before expiry of the period for payment.	

12. Acceleration of procedure

12.1 Early processing	
Early processing of the application pursuant to Article 23(2) / 40(2) PCT is hereby requested (“early entry into the European phase”)	☐
12.2 Waivers	
The applicant waives his right to the communication under Rules 161(1) or (2) and 162 EPC.	☐
The applicant waives his right to be asked under Rule 70(2) EPC whether he wishes to proceed further with the application.	☐

13. List of enclosed documents

	Description of document	Original file name	Assigned file name

14. Method of payment: Debit from deposit account ☒

Currency	EUR
The European Patent Office is hereby authorised, to debit from the deposit account with the EPO any fees and costs indicated on the fees page.	
Deposit account number	28070103
Account holder	BOTTI & FERRARI S.r.l.

15. Any refunds should be made to the following EPO deposit account: ☒

Number and account holder	BOTTI & FERRARI S.r.l., 28070103

16. Fees

		Factor/reduction applied	Fee schedule	Amount to be paid
16-1	005e Designation fee - For all contracting States designated for applications filed on/after 01.04.2009	1	585.00	585.00
16-2	006e Examination fee - For applications filed before 01.07.2005 and for international applications filed on/after 01.07.2005 without supplementary European search report	0.25	1 825.00	456.25
16-3	015 Claims fee - For the 16th to the 50th claim	0	235.00	0.00
16-4	15e Claims fee - For the 51st and each subsequent claim	0	585.00	0.00
16-5	020 Filing fee - entry EP phase - online	1	120.00	120.00
16-6	520 Additional filing fee for the 36th and each subsequent page - entry into EP phase	16	15.00	240.00
	Total:		EUR	**1 401.25**

17. Annotations

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17. Signature(s) of applicant(s) or representative

Place:	**Milano**
Date:	**08 July 2019**
Signed by:	**Barbara Ferrari 6913**
Representative name:	**Barbara FERRARI**
Capacity:	**(Representative)**

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Table for section 6 of Form 1200.3

In accordance with the Notice from the European Patent Office dated 26 January 2009 concerning the 2009 fee structure (OJ EPO 2009, 118, and Guidelines for Examination in the EPO, April 2009, A-III, 13.2), the amount of the additional fee (Art. 2, item 1a, Rules relating to Fees) for the pages of this European patent application is calculated as follows:

Documents intended for proceedings before the EPO (R. 159 (1) (b) EPC) and for calculating the additional fee (Art. 2, item 1a, RFees):

		Page(s) from ... to ...	Number of pages
Description:	International application as published	1-3, 5-32	31
	Amendments under Art. 34 PCT	4	1
Claims:	Amendments under Art. 34 PCT	33-37	5
Drawings:	International application as published	1-13	13
Abstract:	Default count: one page		1
Total number of pages			51
Fee-exempt pages (Art. 2, item 1a, RFees)			-35
Number of pages to be paid for			16
			(x 15 EUR per page)
Total amount payable		EUR	240

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Europäisches Patentamt
European Patent Office
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Acknowledgement of receipt

We hereby acknowledge receipt of the form for entry into the European phase (EPO as designated or elected Office) as follows:

Submission number	7646103
PCT application number	PCT/EP2017/082180
EP application number	17825770.5
Date of receipt	08 July 2019
Receiving Office	European Patent Office, The Hague
Your reference	TEC076WEP
Applicant	
Country	
Documents submitted	package-data.xml application-body.xml ep-euro-pct.xml epf1200.pdf (5 p.)
Submitted by	CN=Barbara Ferrari 6913
Method of submission	Online
Date and time receipt generated	08 July 2019, 16:04 (CEST)
Message Digest	20:5D:46:DC:14:4E:A9:EF:59:E0:09:CA:BB:12:09:41:73:66:0D:DE

Correction by the EPO of errors in debit instructions filed by eOLF
Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82, OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

/European Patent Office/

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Europäisches Patentamt
European Patent Office
Office européen des brevets

European Patent Office
80298 MUNICH
GERMANY

Questions about this communication ?
Contact Customer Services at www.epo.org/contact

MAGGIONI, Flavio
c/o TECHNOPROBE S.p.A.
Via Cavalieri di Vittorio Veneto 2
23870 Cernusco Lombardone (Lecco)
ITALIE

Date
19.07.19

Reference	Application No./Patent No.
	17825770.5 - 1022
Applicant/Proprietor	
Technoprobe S.p.A	

Notification of the data mentioned in Rule 19(3) EPC

In the above-identified patent application you are designated as inventor/co-inventor.
Pursuant to Rule 19(3) EPC the following data are notified herewith:

DATE OF FILING	: 11.12.17
PRIORITY	: IT/16.12.16/ ITA201600127581 : IT/24.02.17/ ITA201700021389
TITLE	: TESTING HEAD HAVING IMPROVED FREQUENCY PROPERTIES
DESIGNATED STATES	: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

For the Examining Division

Europäisches Patentamt • European Patent Office • Office européen des brevets

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European Patent Office
Office européen des brevets

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GERMANY

Questions about this communication ?
Contact Customer Services at www.epo.org/contact

Ferrari, Barbara
Botti & Ferrari S.r.l.
Via Cappellini, 11
20124 Milano
ITALIE

Date
24.07.19

Reference	Application No./Patent No.
TEC076WEP	17825770.5 - 1022
Applicant/Proprietor	
Technoprobe S.p.A	

Communication pursuant to Rules 161(1) and 162 EPC

1. Correction of deficiencies noted in the written opinion and amendment of the application (R. 161(1) EPC)

The above-mentioned international (Euro-PCT) application has entered the European phase.

The EPO as International Searching Authority and, where a demand under Article 31 PCT was filed, also as International Preliminary Examining Authority has drawn up a written opinion on this application or the EPO as Supplementary International Searching Authority has issued explanations pursuant to Rule 45*bis*.7(e) PCT to the supplementary international search report.

You are invited to correct any deficiencies noted in the written opinion of the International Searching Authority or in the International Preliminary Examination Report, or in the explanations to the supplementary international search report and to amend the description, claims and any drawings within a **non-extendable period of six months** after notification of the present invitation.

Should you not comply with or comment on this invitation within the time limit, **the application will be deemed to be withdrawn** in accordance with Rule 161(1) EPC.

2. Amendment of application

Under Articles 28, 41 PCT and Rules 52, 78 PCT the application may be amended before a designated or elected Office, and in accordance with Rule 137(2) EPC the applicant may amend the description, claims and drawings of his own volition together with any comments, corrections or amendments made in response to the communication under Rule 161(1) EPC.

Whether or not you have already done so, you now have a further opportunity to file amended claims or other application documents within the above-mentioned period.

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

The claims applicable on expiry of the above period, i.e. those filed on entry into the European phase or in response to the present communication, will form the basis for the calculation of any claims fee to be paid (see page 2).

3. Claims fees under Rule 162 EPC

If the application documents on which the European grant procedure is to be based comprise more than fifteen claims, a claims fee shall be payable for the sixteenth and each subsequent claim within the period provided for in Rule 159(1) EPC.

☐ Based on the application documents currently on file, all necessary claims fees have already been paid (or the documents do not comprise more than 15 claims).

☐ All necessary fees will be debited automatically according to the automatic debit order.

☑ The claims fees due for the claims 16 to 21 were not paid within the above-mentioned period.

Any outstanding claims fee, either based on the current set of claims or on any amended claims to be filed pursuant to Rule 161 EPC (see page 1), may still be validly paid within a **non-extendable period of six months** after notification of this communication (R. 162(2) EPC).

If a payment is made for only some of the claims, you must indicate for which claims it is intended. If a claims fee is not paid in due time, the claim concerned is deemed to be abandoned (R. 162(4) EPC).

If claims fees have already been paid, but on expiry of the above-mentioned period there is a new set of claims containing fewer fee-incurring claims than before, the claims fees in excess of those due under Rule 162(2), second sentence EPC will be refunded (R. 162(3) EPC).

The claims fee is currently

EUR 235 for the 16th and each subsequent claim up to the limit of 50
EUR 585 for the 51st and each subsequent claim

Making payments
For payments made via deposit account, please note that as from 1 December 2017 debit orders will only be carried out if filed in an electronically processable format (xml), using an accepted means of filing as laid down in the Arrangements for deposit accounts (ADA), published in the Supplementary publication in the Official Journal.

All relevant information related to the modes of payment of fees to the EPO can be retrieved from the EPO website at "**Making Payments**".

Information concerning fee amounts
Procedural fees are usually adjusted every two years, on even years, with effect from 1 April. Therefore, before making a payment, parties should verify the amounts actually due on the date of payment using the applicable version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, available on the EPO website (**www.epo.org**) at **www.epo.org/schedule-of-fees**. The "Schedule of fees" table allows the viewing, downloading and searching of individual fee amounts, both current and previous.

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Important note to users of the automatic debiting procedure
Unless the EPO receives prior instructions to the contrary, the fees for all claims incurring fees will be debited on the last day of the period for payment.

For the Examining Division



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European Patent Office
Office européen des brevets

European Patent Office
80298 MUNICH
GERMANY

Questions about this communication ?
Contact Customer Services at www.epo.org/contact

Ferrari, Barbara
Botti & Ferrari S.r.l.
Via Cappellini, 11
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ITALIE

Date
25.09.19

Reference	Application No./Patent No.
TEC076WEP	17825770.5 - 1022 / 3555638
Applicant/Proprietor	
Technoprobe S.p.A	

Communication of European publication number and information on the application of Article 67(3) EPC

Provisional protection under Article 67(1) and (2) EPC in the individual contracting states becomes effective when the conditions referred to in Article 67(3) EPC have been fulfilled. Provisional protection in the individual extension and validation states is governed by the national laws of the countries concerned. For more details, see Chapter III of the EPO brochure "National Law relating to the EPC" (**www.epo.org/law-practice/legal-texts/national-law.html**), which also contains information about the extension and validation system. Further information can also be found in the Official Journal of the European Patent Office.

Pursuant to Article 153(3) EPC the publication under Article 21 PCT of an international application for which the European Patent Office is a designated or elected Office takes the place of the publication of a European patent application.

The bibliographic data of the above-mentioned Euro-PCT application will be published on 23.10.19 in Section I.1 of the European Patent Bulletin. The European publication number is 3555638.

In all future communications to the European Patent Office, please quote the application number plus Directorate number.

For the Examining Division

Europäisches Patentamt • European Patent Office • Office européen des brevets •

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IPR2024-00933

Europäisches Patentamt
European Patent Office
Office européen des brevets

Letter accompanying subsequently filed items

Representative:

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17825770.5
Applicant's or representative's reference	TEC076WEP

	Description of document	Original file name	Assigned file name
1	Reply to search opinion/written opinion/IPER	TEC076WEP-reply rule 161-162.pdf	WOREPLY-1.pdf
2	Amended claims (clean copy)	TEC076WEP-amended claims clean.pdf	CLMS-1.pdf
3	Amended claims with annotations	TEC076WEP-amended claims redlined.pdf	CLMS-HWA-1.pdf

	Fees	Factor applied	Fee schedule	Amount to be paid
15-1	015 Claims fee - For the 16th to the 50th claim	3	235.00	705.00
	Total:		**EUR**	**705.00**

	Payment	
1	Method of payment	Debit from deposit account
	Currency:	EUR
	The European Patent Office is hereby authorised, to debit from the deposit account with the EPO any fees and costs indicated on the fees page.	
	Deposit account number:	28070103
	Account holder:	BOTTI & FERRARI S.r.l.
2	Refund/Reimburserment	
	Reimbursement (if any) to be made to EPO deposit account:	28070103
	Account holder:	BOTTI & FERRARI S.r.l.

Signatures

Place: **Milano**

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Date:	**20 January 2020**
Signed by:	**Barbara Ferrari 6913**
Representative name:	**Barbara FERRARI**
Capacity:	**(Representative)**

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FormFactor v. Technoprobe
IPR2024-00933

BOTTI & FERRARI

BREVETTI & MARCHI
EUROPEAN PATENT & TRADEMARK ATTORNEYS

MILANO – BOLOGNA – BRESCIA

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Cap. Soc. 90,000 Euro
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Sabrina Fumagalli [3]

Umberto Zambardino [1]
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[4] *San Marino Agent*
[5] *Attorney at Law*

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EPO
EUROPEAN PATENT OFFICE
D-80298 München
GERMANY

Milano, January 20, 2020

Your ref.: ***17825770.5-1022***
Our ref.: ***TEC076WEP/BF/TS***

Re: European Patent Application No. ***17825770.5*** *filed on December 11, 2017 and concerning a:* "Testing head having improved frequency properties" *in the name of:* ***TECHNOPROBE S.p.A.***

Response to the International Search Report and the Written Opinion of the International Search Authority

---

Dear Sirs,

in response to the Communication pursuant to Rules 161(2) and 162 EPC issued on July 24, 2019 in connection with the above-identified application, the Applicant wishes to proceed the examination with a new set of claims herewith enclosed. The Applicant wishes also to submit arguments relating to the objections raised in the Written Opinion accompanying the International Preliminary Report on Patentability issued for the original PCT application No. PCT/EP2017/082180.

1. Amendments

An amended set of claims is herewith enclosed and is intended to substitute the claims of the application as originally filed. In particular, the starting set of claims is the one filed with the Demand. Care has been taken to comply with the requirements of Art. 123(2) EPC.

In particular, independent claim 1 has been amended in order to claim the following combination of features:

"A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41) provided with a plurality of guide holes (40h, 41h), and a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h), each of said contact elements (21', 21", 21'")

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comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), wherein said at least one guide (40, 41) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41') of said guide holes (40h, 41h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41') of said guide holes (40h, 41h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41") of said guide holes (40h, 41h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41") of said guide holes (40h, 41h), wherein the contact elements of a same group are adapted to carry a same type of signal, wherein the contact elements of different groups are adapted to carry different types of respective signals, and wherein said first contact elements (21') housed in said first group (40', 41') of said guide holes (40h, 41h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41") of said guide holes (40h, 41h) are adapted to carry power signals, and wherein said guide including the conductive portions (30', 30") is a lower guide (40) or an intermediate guide (41) of the testing head (20)" *(emphasis added).*

Support for the above amendment can be found in previously filed dependent claim 2, which is now completely included in amended independent claim 1. See also page 11, lines 7-20 and lines 21-29, page 13, lines 12-21, and page 15, lines 11-24 of the specification.

Moreover, support for the expression "wherein said guide including the conductive portions (30', 30") is a lower guide and/or an intermediate guide of the testing head (20)" *is found in the description text of the present application at page 20, lines 4-7, as well as in figures 2A-2C and 4A-4B. See also page 31, lines 19-24.*

Previously filed dependent claim 2 has thus been deleted. Also previously filed dependent claims 8 and 19 have been deleted. The remaining dependent claims have been renumbered and the dependencies have been corrected accordingly.

The references signs in the claims have been amended for consistency with amended claim 1.

The amendments therefore meet the requirements of Art. 123(2) EPC.

It is also observed that the skilled man well knows the meaning of "probes adapted to carry ground signals" *and* "probes adapted to carry power signals", *which are well established terms and widely used in the field. More in particular, the use of such expressions clearly identifies the specific kind of signal carried by such probes as well as the physical characteristics thereof.*

Moreover, it is also respectfully observed that the terms "lower guide" *and* "intermediate

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guide" *are well established terms in the field of probe cards, the former indicating the guide that is closest to the device under test (DUT) and the latter indicating the guide that is disposed between the lower guide and the PCB/test equipment/upper guide (and is generally closer to the lower guide), in any case said guides being closer to the DUT, as specified in the description text.*

Finally, it is observed that new dependent claim 10 (i.e. previously filed claim 12) has been amended to clarify that the contact elements are contact probes, as shown in the embodiments of figures 2A-2C, 4A-4B, 5A-5B and 6, the term "contact probe" *clearly identifying a specific type of elongated probing element used in this technical field.*

The claims therefore meet the requirements of Art. 84 EPC.

The annexes include the new set of claims. Marked-up pages are included for the Examiner's convenience.

*** ** * ** ***

2. *Remarks*

In the Written Opinion, the subject-matter of independent claim 1 of the present application has been considered as lacking an inventive step in view of the teachings of document D2 (i.e. Korean patent n. KR 101 421 051 B1).

The Applicant has duly considered the Examiner's objections and believes that independent claim 1 as amended is new and inventive over the cited prior art for the following reasons.

Document D2 discloses a probe head equipped with ground probes and auxiliary probes (called "conductive wires", reference number 30) which surround signal or power probes, the ground probes being short-circuited together with the auxiliary probes by a conductive layer on the guide.

It is observed that the conductive layer of D2 connects to each other only ground probes, while the power probes are not connected to each other and are surrounded by the short-circuited ground probes. Therefore, the metal layers of D2 are clearly not intended to electrically connect different groups of probes that carry respective different types of signals, i.e. ground signals and power signals, as instead claimed in the present application.

According to amended claim 1 of the present application, there are at least two conductive portions configured to connect to each other respective contact probes which are adapted to carry a different type of signal: one group of short-circuited probes carries ground signals and the other group of short-circuited probes carries power signals, such probes being thus functionally different.

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As also acknowledged by the Examiner, the present application is new over the prior art under Art. 54 EPC at least for the above reasons.

Moreover, it is respectfully observed that the combination of features of new independent claim 1 has several advantages and that the present application is also inventive over the cited prior art.

In particular, the disclosed invention achieves an overall improvement of the frequency performances of the testing head, since the different conductive portions represent common ground planes and common power planes with many beneficial effects not disclosed in the prior art documents.

First of all, the common ground planes help in reducing the noise due to ground probes, as well as the common power planes help in reducing the noise due to power probes (it is in fact observed that a power distribution behaves like a ground distribution), such noise negatively affecting the signal carried by the signal probes. Using the wording of amended claim 1, by sharing the ground paths via the first conductive portion 30' and by sharing the power paths via the second conductive portion 30'', the noise of both signals is reduced; since the DUT is sensitive to both the ground and power noise, the testing, in particular at high frequencies, is improved thanks to the solution of the present application.

More in particular, it is known that the fixed layout of the ground and power probes (which results from the layout of the pads of DUT) limits the impedance control as well as the control of the noise caused on the operative signals by the ground and power probes. The use of a common ground plane and of a common power plane arranged as close as possible to the DUT (i.e. on the lower/medium guide) helps in solving this issue. In this way, the various ground/power probes (i.e. probes of a same domain) are short-circuited by the conductive portions near to the DUT and not on the PCB, improving the electrical performances and also reducing inductance loops, thus without transporting the relative signal of the test equipment. As a specific example, common metal power planes help in reducing the inductance loops and the equivalent resistance of the system, as the current flowing in each power probe is now shared by all the probes connected to the metal portion on the guide.

The use of common power planes also reduces the common mode noise, as disclosed in the specification.

In document D2 there is no suggestion of short-circuiting different groups of probes by means of different conductive portions; in other words, there is no suggestion of using common metal planes for ground and power probes, and the power probes are never short-circuited. More in particular, by following the teachings of D2, the skilled man would be prompted to connect to each other only ground probes, without any hint toward the solution of the present application.

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Summing up, when faced with the technical problem of the present application, the skilled man would not have found any hint in D2 that would have prompted him to modify the probe head disclosed therein to obtain the solution of the present application.

For all the above reasons, it is respectfully submitted that the subject-matter of amended independent claim 1 is endowed with the required inventive step under Art. 56 EPC over document D2.

*** ** * ** ***

The Applicant respectfully remarks that the above indicated features of new independent claim 1, which distinguish it over document D2, are not disclosed nor suggested in documents D1, D3 and D4 either and that, starting from document D2, the skilled man would not have found in such documents any teaching allowing him to fill the many differences between D2 and the patent application in re.

More in particular, document D3 (i.e. US 2014/0197860 A1) discloses a testing head comprising a guide equipped with a current-diverting circuit to which all the probes are connected. The current-diverting circuit of D3 comprises traces divided into primary branches (reference 52) and secondary branches (reference 54) connecting power probes to each other. More in particular, document D3 does not distinguish among ground and power probes, and all the probes of D3 are indistinctly connected to the diverting circuit; in other words, there is no mention of different contact probes carrying different types of signals and being short-circuited by respective common metal planes. The conductive branches of D3 are formed on both lower and upper guide, and not only on lower/intermediate guide as in the present application.

Moreover, no mention of the technical effect of reducing noise is present in D3, which only focuses about the problem of probe burning. Therefore, the skilled man, starting from D2 and facing the problem of improving the frequency performances, would not consider D3 in order to obtain the invention disclosed in the present application. The layer of D3 is in fact on both guides for reducing the probability of burning of the power probes, while according to the present application, reduction of the noise is achieved when the plate is on the lower/intermediate guide, i.e. closer to the DUT, so that no motivation for combination is provided in the prior art. In fact, the problem of improving frequency performances by connecting power probes is never mentioned in the prior art documents.

Similar considerations also hold for document D4 (i.e. WO 2012/106220 A1), which discloses a socket for an integrated circuit allowing the setting of a plurality of power sources or grounds. As seen for D3, it is observed that the layers of D4 are not used to improve the frequency performances of the system, as instead provided in the present application, but only for setting a plurality of power sources in the socket. Therefore, the skilled man, facing the problem tied to the frequency performances, would not consider D4 in order to obtain the invention disclosed in the present application, as the aim of the present application is reducing noise which is achieved by arranging a short-circuit for

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the ground and power probes on the lower guide of the testing head. The embodiments of D4 would not solve the problem of the present application as they will not help in reducing the noise and the improvement of the frequency performances is not even mentioned in such document.

Finally, it is newly observed that the socket of D4 is not comparable to a testing head comprising a lower/medium guide adapted to house a plurality of contact probes, as instead claimed in the patent application in re. In particular, the layers of D4 are not formed on a guide of a testing head, in particular on a lower/intermediate guide, which is fundamental for the present application; more specifically, D4 discloses a substrate having a base material in turn having dielectric and conductive layers embedded, but a "lower or intermediate guide" (as known in the field) cannot be identified in D4, so that this document discloses a socket having a different structure that can hardly be combined with the other prior art documents.

In conclusion, the subject-matter of amended independent claim 1 and of the claims dependent thereon is endowed with the required inventive step under Art. 56 EPC over all the cited prior art documents, taken alone or in combination.

*** ** * ** ***

3. Conclusions

In view of the above, it is believed that all the claims of the present application meet the requirements of the European Patent Convention and a favourable Examiner's decision in this respect is hereby solicited.

Should the Examining Division be of a different opinion, an informal interview or oral proceedings under Art. 116 EPC by videoconference using IP technology are hereby respectfully requested.

Many thanks and best regards.

Yours Sincerely,
The Representative
Barbara Ferrari

Encl.: amended set of claims; and
marked-up pages

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CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41~~, 42~~) provided with a plurality of guide holes (40h, 41h~~, 42h~~), and a plurality of contact elements (21', 21", 21'") housed in said guide holes (40h, 41h~~, 42h~~), each of said contact elements (21', 21", 21'") comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), ~~said testing head (20) being characterized in that~~ wherein said at least one guide (40, 41~~, 42~~) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41'~~, 42'~~) of said guide holes (40h, 41h~~, 42h~~) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41'~~, 42'~~) of said guide holes (40h, 41h~~, 42h~~), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41"~~, 42"~~) of said guide holes (40h, 41h~~, 42h~~) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41"~~, 42"~~) of said guide holes (40h, 41h~~, 42h~~), wherein the contact elements of a same group are adapted to carry a same type of signal, ~~and~~ wherein the contact elements of different groups are adapted to carry different types of respective signals~~,~~ and

~~2. The testing head (20) according to claim 1, characterized in that~~ wherein said first contact elements (21') housed in said first group (40', 41'~~, 42'~~) of said guide holes (40h, 41h~~, 42h~~) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41"~~, 42"~~) of said guide holes (40h, 41h~~, 42h~~) are adapted to carry power signals, and wherein said guide including the conductive portions (30', 30") is a lower guide (40) or an intermediate guide (41) of the testing head (20).

~~3~~2. The testing head (20) according to claim 1 ~~or 2~~, characterized in

that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41~~, 42~~), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41~~, 42~~).

~~4~~3. The testing head (20) according to ~~any one of the preceding claims~~claim 1 or 2, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

~~5~~4. The testing head (20) according to claim ~~4~~3, characterized in that said at least one guide (40, 41~~, 42~~) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

~~6~~5. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

~~7~~6. The testing head (20) according to any one of the claims from 1 to ~~5~~4, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42),

said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"), said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

~~8. The testing head (20) according to claim 6 or 7, characterized in that said first contact elements (21') housed in said first group (40', 41', 42') of said guide holes (40h, 41h, 42h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41", 42") of said guide holes (40h, 41h, 42h) are adapted to carry power signals.~~

~~9~~7. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30'") that includes and electrically connects the holes of a third group (40'", 41'"~~, 42'"~~) of said guide holes (40h, 41h~~, 42h~~) to each other, said third group (40'", 41'"~~, 42'"~~) housing third contact elements (21'").

~~10~~8. The testing head (20) according to claim ~~9~~7, characterized in that said third contact elements (21'") housed in said third group (40'", 41'"~~, 42'"~~) of said guide holes (40h, 41h~~, 42h~~) are adapted to carry input/output signals between the device under test and a test equipment.

~~11~~9. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") covers at least one portion (40'W, 40"W , 40'"W; 41'W, 41"W, 41'"W) of an inner surface of each guide hole of said group (40', 40", 40'"; 41',

41", 41'") of said guide holes (40h, 41h).

~~12~~10. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21'") are contact probes ~~wherein said body (21pr) has a deformation~~.

~~13~~11. The testing head (20) according to any one of the claims from 1 to ~~5~~4, characterized in that said contact elements (21', 21", 21'") are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1~~, S2~~) being apt to abut onto said at least one guide (40~~, 42~~), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said ~~first and/or second~~ surface (S1~~, S2~~).

~~14~~12. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41~~, 42~~) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

~~15~~13. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41~~, 42~~) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41~~, 42~~).

~~16~~14. The testing head (20) according to any one of the claims from 1 to ~~14~~12, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41~~, 42~~), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41'~~, 42'~~; 40", 41"~~, 42"~~; 40'", 41'"~~, 42'"~~) of said guide holes (40h, 41h~~, 42h~~) to each other, with the exception of areas where guide holes not belonging to said at least one

group (40', 41', ~~42'~~; 40", 41", ~~42"~~; 40"', 41"', ~~42"'~~) are formed.

~~17~~15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41, ~~42~~) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h, ~~42h~~) apt to house a single contact element, said at least one guide (40, 41, ~~42~~) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

~~18~~16. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41, ~~42~~).

~~19. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') comprises a plurality of conductive portions overlapped to and electrically insulated from each other.~~

~~20~~17. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h, ~~42h~~) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21"'), said contact elements included in said respective groups being adapted to carry a same type of signal.

~~21~~18. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41, ~~42~~).

CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41) provided with a plurality of guide holes (40h, 41h), and a plurality of contact elements (21', 21", 21"') housed in said guide holes (40h, 41h), each of said contact elements (21', 21", 21"') comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), wherein said at least one guide (40, 41) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41') of said guide holes (40h, 41h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41') of said guide holes (40h, 41h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41") of said guide holes (40h, 41h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41") of said guide holes (40h, 41h), wherein the contact elements of a same group are adapted to carry a same type of signal, wherein the contact elements of different groups are adapted to carry different types of respective signals, and wherein said first contact elements (21') housed in said first group (40', 41') of said guide holes (40h, 41h) are adapted to carry ground signals, and said second contact elements (21") housed in said second group (40", 41") of said guide holes (40h, 41h) are adapted to carry power signals, and wherein said guide including the conductive portions (30', 30") is a lower guide (40) or an intermediate guide (41) of the testing head (20).

2. The testing head (20) according to claim 1, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41).

3. The testing head (20) according to claim 1 or 2, characterized in that said at least one conductive portion (30', 30", 30"') is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

4. The testing head (20) according to claim 3, characterized in that said at least one guide (40, 41) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

5. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

6. The testing head (20) according to any one of the claims from 1 to 4, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"), said first conductive portion (30') and said second conductive portion

(30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

7. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30"') that includes and electrically connects the holes of a third group (40"', 41"') of said guide holes (40h, 41h) to each other, said third group (40"', 41"') housing third contact elements (21"').

8. The testing head (20) according to claim 7, characterized in that said third contact elements (21"') housed in said third group (40"', 41"') of said guide holes (40h, 41h) are adapted to carry input/output signals between the device under test and a test equipment.

9. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') covers at least one portion (40'W, 40"W , 40"'W; 41'W, 41"W, 41"'W) of an inner surface of each guide hole of said group (40', 40", 40"'; 41', 41", 41"') of said guide holes (40h, 41h).

10. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21"') are contact probes.

11. The testing head (20) according to any one of the claims from 1 to 4, characterized in that said contact elements (21', 21", 21"') are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1) being apt to abut onto said at least one guide (40), the electrical connection between said contact elements (21', 21", 21"') and said at least one conductive portion (30', 30", 30"') being a pressing contact through said surface (S1).

12. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one common pad (36', 36", 36"') connected to said at least one conductive

portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

13. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41).

14. The testing head (20) according to any one of the claims from 1 to 12, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41'; 40", 41"; 40'", 41'") of said guide holes (40h, 41h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41'; 40", 41"; 40'", 41'") are formed.

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h) apt to house a single contact element, said at least one guide (40, 41) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

16. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30'") is embedded in said at least one guide (40, 41).

17. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide

holes (40h, 41h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21'"), said contact elements included in said respective groups being adapted to carry a same type of signal.

18. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41).

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

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Application number	EP17825770.5
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Receiving Office	European Patent Office, The Hague
Your reference	TEC076WEP
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (2 p.) CLMS-1.pdf\TEC076WEP-amended claims clean.pdf (5 p.) ep-sfd-request.xml WOREPLY-1.pdf\TEC076WEP-reply rule 161-162.pdf (6 p.) CLMS-HWA-1.pdf\TEC076WEP-amended claims redlined.pdf (5 p.)
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Message Digest	EC:04:2B:FA:D8:73:67:8F:C8:F2:1C:A7:52:95:94:54:18:D5:F3:61

Correction by the EPO of errors in debit instructions filed by eOLF
Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82, OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17825770.5
Applicant's or representative's reference	TEC076WEP

Request:

- Enquiry as to the processing of the file

	Description of document	Original file name	Assigned file name
1	Enquiry as to the processing of the file – electronically generated		EPF1012.PDF

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**Milano**
Date:	**10 November 2020**
Signed by:	**Rinaldo Ferreccio 6912**
Representative name:	**Rinaldo FERRECCIO**
Capacity:	**(Representative)**

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Enquiry as to the processing of the file

I/we hereby enquire when the EPO will deliver the (supplementary) European search report / next communication[1]

for application/patent 17825770.5

[1] OJ EPO 2016, A66

Signatures

Place:	**Milano**
Date:	**10 November 2020**
Signed by:	**Rinaldo Ferreccio 6912**
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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	9198197	
Application number	EP17825770.5	
Date of receipt	10 November 2020	
Receiving Office	European Patent Office, The Hague	
Your reference	TEC076WEP	
Applicant	All applicants as on file	
Documents submitted	package-data.xml epf1038.pdf (1 p.)	ep-sfd-request.xml epf1012.pdf (1 p.)
Submitted by	CN=Rinaldo Ferreccio 6912	
Method of submission	Online	
Date and time receipt generated	10 November 2020, 15:45 (CET)	
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Questions about this communication ?
Contact Customer Services at www.epo.org/contact

Ferrari, Barbara
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Date
24.11.20

Reference	Application No./Patent No.
TEC076WEP	17825770.5 - 1010 / 3555638
Applicant/Proprietor	
Technoprobe S.p.A	

Communication in response to your enquiry received on 10.11.20

☑ The EPO will be able to supply a communication within 06 month(s).

☐ Having regard to the current workload, the EPO will not be able to supply a communication within the next 12 months.

☐ Reference is made to the telephone consultation that took place on .

If the proposed time frame does not meet your needs, please contact the responsible examiner or the director:

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General information:
If you wish your application to be examined more quickly than the time frame indicated above, your attention is drawn to the possibility of requesting accelerated examination under the "PACE" programme of the EPO (OJ EPO 2015, A93). However, if a request for accelerated examination has already been filed and the application has been removed from the PACE programme, a second request for accelerated examination can no longer be processed (OJ EPO 2015, A93, point 4).

For the Examining Division

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BOTTI & FERRARI

BREVETTI & MARCHI
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EPO
EUROPEAN PATENT OFFICE
Directorate 5.2.3- Legal Division
80298 Munich
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by email: legaldivision@epo.org

Milano, January 5, 2021

Re: Change of the legal form

Dear Sirs,

Please be informed that our legal form changed from Botti & Ferrari S.r.l. to

Botti & Ferrari S.p.A.

Therefore, we kindly ask you to update your records in connection with the following Representatives:

BOTTI Mario
FERRARI Barbara
FERRECCIO Rinaldo
ZAMBARDINO Umberto
GERLI Paolo
ANTONUCCI Emanuele
ZELIOLI Giovanni
PIO Federico

Best regards.

Yours Sincerely,
The Representative

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Application No.: 17825770.5

Substantive examination has started on 12.05.21 (see Notice from the European Patent Office dated 29.01.2013, OJ EPO 2013, 153).

For the Examining Division

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Application No.	Ref.	Date
17 825 770.5 - 1010	TEC076WEP	20.05.2021
Applicant Technoprobe S.p.A		

Communication pursuant to Article 94(3) EPC

The examination of the above-identified application has revealed that it does not meet the requirements of the European Patent Convention for the reasons enclosed herewith. If the deficiencies indicated are not rectified the application may be refused pursuant to Article 97(2) EPC.

You are invited to file your observations and insofar as the deficiencies are such as to be rectifiable, to correct the indicated deficiencies within a period

of 4 months

from the notification of this communication, this period being computed in accordance with Rules 126(2) and 131(2) and (4) EPC. One set of amendments to the description, claims and drawings is to be filed within the said period on separate sheets (R. 50(1) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

In case you withdraw the application within the above-mentioned period, the examination fee will be refunded at a rate of 50% (Art. 11 (b) RFees).

Failure to comply with this invitation in due time will result in the application being deemed to be withdrawn (Art. 94(4) EPC).

Registered letter

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Hijazi, Ali
Primary Examiner
For the Examining Division

Enclosure(s): 6 page/s reasons (Form 2906)

Translation of document: KR-101421051-B1

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The examination is being carried out on the **following application documents**

Description, Pages

1-3, 5-32	as published
4	as annexed to the Int. Prel. Examination Report

Claims, Numbers

1-18	filed in electronic form on	20-01-2020

Drawings, Sheets

1/13-13/13	as published

1 The following documents have been cited in the international search report:

D1 US 2012/242360 A1 (HUANG KENG-YI [TW] ET AL) 27 September 2012 (2012-09-27)

D2 KR 101 421 051 B1 (WILL TECHNOLOGY CO LTD [KR]) 22 July 2014 (2014-07-22)

D3 US 2014/197860 A1 (HSU HSIEN-TA [TW] ET AL) 17 July 2014 (2014-07-17)

D4 WO 2012/106220 A1 (3M INNOVATIVE PROPERTIES CO [US]; KAWATE YOSHIHISA [JP]; TSUBAKI YUICH) 9 August 2012 (2012-08-09)

2 Novelty, inventive step.

2.1 Claim 1.

2.1.1 D2 discloses:

A testing head (Figs. 3, 4) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (11, 12) provided with a plurality of guide holes (11b, 11b', 12b, 12b') and

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a plurality of contact elements (20) housed in said guide holes, each of said contact elements comprising a body (30) that extends between a first end portion and a second end portion, wherein said at least one guide comprises at least one first conductive portion (40a, 40b) that includes the holes of at least one first group of said guide holes and electrically connects (see Fig. 4, corresponding to G connection) a corresponding first group of said contact elements housed in said at least one first group of said guide holes, and

~~at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,~~

wherein the contact elements of a same (here the first group as defined in D2) group are adapted to carry a same type of signal, and

~~wherein the contact elements of different groups are adapted to carry different types of respective signals and~~

wherein said first contact elements housed in said first group of said guide holes are adapted to carry ground signals (see again Fig. 4, corresponding to G connection), and

~~said second contact elements housed in said second group of said guide holes are adapted to carry power signals, and~~

wherein said guide including the first conductive portion is a lower guide or an intermediate guide of the testing head (a conductive portion for the ground G is located on the lower portion).

2.1.2 The subject-matter of claim 1 differs from D2 in that the testing head further comprises:

at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes,

wherein the contact elements of a same (here the second group) group are adapted to carry a same type of signal, and

wherein the contact elements of different groups are adapted to carry different types of respective signals.

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said second contact elements housed in said second group of said guide holes are adapted to carry power signals, and

wherein said guide including the second conductive portion is a lower guide or an intermediate guide of the testing head

At this point it is noted that it is not possible to determine whether contact elements are adapted to carry different types of respective signals as the claim does not specify whether the contact elements are connected to ground or to a power supply for instance. Furthermore, the claim does not specify geometric differences which could also possibly be seen as a manner of adapting the contact elements for different types of signal (for instance size of the contact elements, of the conductive portions, as far as this is disclosed in the application). For these reasons, this aspect of the claim can only be interpreted as meaning that the two groups are electrically separated so that they may be used to carry different types of signals.

The Applicant argues in the letter of 20.01.2020, at the end of page 2, that these are well established terms. However, which signals are carried by a probe relates to the use of the testing head which is not an appropriate limitation for a device claim. A "normal" standard testing head could have all probes of the same size with nothing special distinguishing them and still some of the probes could be used either for ground or for power supply according to the circumstances (the type of DUT).

Similarly, whether a guide is lower or intermediate is not a proper limitation for a device claim which can be placed upside down on a table. That the lower guide should correspond to the part closer to the DUT is not specified in claim 1.

2.1.3 The technical effect of these differences is not immediately apparent. The applicant has argued that this leads to an overall improvement of the frequency performance of the testing head. However, for instance, if the two groups are directed to a ground group on one hand and a power supply group on the other hand (like possible with the present wording of claim 1) then such frequency performance improvement is not necessary occurring, especially also because a grouping of ground connected contact elements is already done.

2.1.4 In the letter of 20.01.2020, page 4, the Applicant that the disclosed invention achieves an overall improvement of the frequency performances because of the common ground and power planes. Such planes are not defined in the claim and the test head is not even specified as being suitable for testing high

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frequency components, so that this argumentation does not appear to apply to claim 1. Again, whether the conductive portions are "near" the DUT or not cannot be deduced from the wording of claim 1.

At present it appears therefore that the grouping of a second group of contact elements is merely directed to an arbitrary design construction which the skilled person would implement according to the circumstances. For instance the second group could be a repetition of the first group used to test in parallel with a second component of the wafer. Furthermore many reasons to do such grouping appears to exist some being mentioned on page 2 of D4 with corresponding solutions mentioned on page 8 of D4.

2.1.5 Another manner of assessing the above mentioned difference would be to assume that the second group is directed to power signals, like apparently the Applicant has attempted to limit claim 1 in view of its present wording. In that case one possible effect of such grouping would be to split the current drawn by the DUT within several paths in order to avoid that too much current is drawn in a probe.

D3 address this problem by using the arrangement shown in Figs. 3 to 6. Fig. 4 discloses the above mentioned distinguishing features , see the conductive portion 50 including holes 40 arranged to house probes 22. The type of signal is here power. It is further referred to paragraphs 0027 to 0030 and 0035 which provide details on these aspects.

The skilled person wishing to solve the above mentioned problem (i.e. reduction of current flowing through a power probe) would get in D3 a teaching that he would incorporate without problem in the testing head of D2, arriving therefore in an obvious manner to the claimed subject-matter. The incorporation of the conductive portion (lines) in the lower guide of D2 is a mere matter of lines routing on the guide which is within the customary practice of the skilled person.

The Applicant argues (still at page 4 of the letter) that D2 does not suggest to short-circuit two groups of probes. However, D2 already discloses the short-circuiting of a first group while D3 discloses the short-circuiting of a second group and this is why the combination is at the end relevant to the claimed subject-matter. A hint in D2 itself is not mandatory, what is relevant is more whether the skilled person would have an incentive in general to implement such changes in D2 which appears to be the case in view of the stated problem and the teaching of D3. A more specific problem cannot be deduced from the present wording of claim 1 and for that reasons, the argumentation of page 5 of

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the letter concerning the reduction of noise cannot be followed. It is further noted that D2 also mention that noise considerations are forming part of its disclosure, see paragraph 0011.

2.1.6 Lastly, even if one would come to a technical effect linked to the improvement of the frequency performance of the testing head of D2, the mere fact of placing signal routing as near as possible from the DUT (and therefore by doing so de facto creating groups of contact probes) appears to be well known to the skilled person and therefore the subject-matter of claim 1 would also appear from this point of vue not to involve an inventive step either. Again page 8 of D4 appears to provide some teaching on the grouping of probes contacts in the same manner as claimed and as in the present invention. It is true that D4 concerns a socket, as argued on the last page of the letter, this however does not necessarily prevent the skilled person to take some teaching out of it, as it is at least in the same general field of electrical testing. In any case, as explained above, the general argumentation concerning the lack of inventive step of claim 1 is based on the combination of D2 and D3.

2.2 The subject-matter of claim 1 does therefore not involve an inventive step (Article 33(3) PCT).

2.3 At present it appears that none of the claims are patentable as none of these claims would involve an inventive step in view of the cited prior art. For instance claim 2 is rendered obvious by the combination of D2 and D3 as mentioned above or the additional features of claim 17 are already known from D2 (see Fig. 4).

3 It is not at present immediately apparent which part of the application could serve as a basis for a new, allowable claim. Should the Applicant nevertheless regard some particular matter as patentable, a new set of claims should be filed taking into account the above objections. When filing the new claims, the Applicant should:

3.1 Bring the description into conformity with the amended claims **(Rule 42(1)(c) EPC)**;

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3.2 should use the two-part form (**Rule 43(1) EPC**); if the Applicant is of the opinion that such two-part form is not appropriate, reasons therefore should be provided and the features known in combination with the prior art should be acknowledged as such in the description (Guidelines F-IV, 2.3.2);

3.3 should provide the features of the claims with reference signs placed in parentheses in order to increase the intelligibility of the claims (**Rule 43(7) EPC**); and

3.4 should indicate in the letter of reply the difference of the subject-matter of the new independent claim vis-à-vis the state of the art and the significance thereof (e.g.: closest prior art, distinguishing technical features in view of this prior art, problem solved by these distinguishing technical features, unexpected / unforeseeable / surprising effect achieved by these features, further reasons for inventive step).

4 The attention of the Applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (**Article 123(2) EPC**).

In order to facilitate the examination of the conformity of the amended application with the requirements of Article 123(2) EPC, the Applicant is requested to clearly identify the amendments carried out, irrespective of whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (Guidelines H-III, 2.2 and Rule 137(4) EPC).

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KR101421051B1 20140722

THOMSON NATIVE MAT through DFP

SUBJECT OF THE INVENTION
The apparatus for inspection of semiconductor [Device for Semiconductor Test].

[**0001**] The invention relates to the apparatus for inspection of semiconductor. And more specifically, it relates to the apparatus for inspection of semiconductor improving the measurement reliability of the checking object semiconductor by providing the structure, of preventing that the delivered electric signal is mutually interfered through multiple test pins delivering the signal to the checking object semiconductor.

[**0002**] Generally, it can divide into the fabrication inspection which is the EDS (Electrical Die Sorting:EDS) process inspecting the electrical characteristic of the chip in which the semiconductor check process is manufactured by the wafer level and the post-processing inspection inspecting the semiconductor IC manufactured to the package level.

[**0003**] The fabrication inspection has the probe card is the terminal of the wafer the apparatus for inspection of semiconductor called the probe card which applies the electric signal in chips which determine the bad chip among chips comprising the wafer is used and the structure in which multiple test pins (probe needle) are formed in the corresponding position.

[**0004**] The post-processing inspection has the test socket is the multiple pogo pins in the corresponding position in the IC terminal or the structure in which the conductive rubber sheet is installed the apparatus for inspection of semiconductor is used the electric signal is applied in the form of IC in the packaged semiconductor.

[**0005**] Moreover, terminal as to the apparatus for inspection of semiconductor, is formed at one side identically with the terminal of the semiconductor and even when playing the semiconductor package in which such terminal is connected or which is extended to one side of the semiconductor package and which is connected to the inspection (test) the semiconductor package can be used.

[**0006**] Figure 1 is drawing showing the cross-sectional view of the probe card which as an example, is the fabrication test equipment of the conventional apparatus for inspection of semiconductor.

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[**0007**] As shown in fig. 1, the conventional probe card (100) comprises the space transformer (130) which the spatially matches the main board (120) liver having the electrode pattern and optical pitch of the guide plate (110) that have the narrow-pitch it is installed between the guide plate (110) in the upper direction of the guide plate (110), in which multiple test pins (111) electrically contacted with the checking object chip are installed and guide plate (110) and the main board (120), installed separately and guide plate (110) and main board (120) to the bottom surface.

[**0008**] The electric signal is delivered to the checking object semiconductor through the test pin (111) in which the conventional probe card (100) as in the above is contacted with the checking object semiconductor (DUT, device under test) and the fault of the checking object semiconductor (DUT, device under test) is selected according to the electric signal returning.

[**0009**] There can be the problem that the high frequency property measurement of the checking object semiconductor (DUT, device under test) is impossible since it serves of the antenna which generates the electromagnetic wave due to this, the inductance is generated since it has to form so that the test pin is contacted with elasticity in the checking object semiconductor (DUT, device under test) in order to be classified but prevent in case of especially, the test pin (111) of the vertical type the checking object semiconductor from being damaged it is caused by and it has the predetermined length as such conventional probe card (100) is the kind of the test pin (111), a lot, the cantilever type and vertical type.

[**0010**] Moreover, the test pin (111) of the conventional probe card (100) has the test pin (G) for the earth, and the power test pin (P) and the structure where the test pin (S) for the signal is atypically arranged as shown in 2.

[**0011**] Here, the electromagnetic wave is generated in the power test pin (P) or the case where the signal is delivered through the test pin (S) for the signal, and the test pin (S) around for the power test pin (P) or the signal and since it acts on noise on the signal in which the generated electromagnetic wave is delivered through the test pin (S) for the signal the problem that the measurement reliability of the checking object semiconductor (DUT, device under test) measured through the test pin (S) for the signal is degraded is generated.

[**0012**] The invention is provided to solve the above-mentioned problem. And it has the apparatus for inspection of semiconductor serving the structure of preventing that the electric signal delivered through multiple test pins delivering the signal to the checking object semiconductor is interfered in each other in the providing.

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[**0013**] It is inserted and set up in the guide plate and the guide hole in which multiple guide holes and conductive wire supported holes are formed in one side for achieving the purpose and it is inserted and set up in multiple test pins and conductive wire supported holes in which the lower part is electrically contacted with the checking object semiconductor and it is provided among multiple test pins among the power test pin or at least one conductive wire and the multiple test pins arranged in the test pin around for the signal with apparatus for inspection of semiconductor crab including the test pin for the earth and the conductive connection means connecting electrically the conductive wire.

[**0014**] Moreover, the conductive connection means may include the inner surface one side of the guide hole in which at least one test pin for the earth is inserted among multiple guide holes and the conductive trace which is formed in the inner surface one side of the conductive wire supported hole in which the conductive wire is inserted and it is formed in the side of the surface of the guide plate and at least one conductive layer contacted with one side of the test pin for the earth and conductive wire and connects the conductive layer liver in which the test pin for the earth and conductive wire is contacted.

[**0015**] Moreover, the guide plate is combined in the lower part of the cover plate and the cover plate in which at least one first guide hole and the first conductive wire supported hole are formed in one side and at least one second guide hole and the bottom plate in which the second conductive wire supported hole is formed are included in one side and the conductive trace is formed in the upper side or one side of bottom of the cover plate and the conductive layer liver in which the upper end portion one side of the conductive wire in which the upper end portion one side of the test pin for the earth is contacted and conductive layer is contacted is connected and it is more desirable to connect the conductive layer which is formed in the upper side or one side of bottom of the bottom plate and in which one side of the bottom part of the test pin for the earth is contacted and the conductive layer liver in which one side of the bottom part of the conductive wire is contacted.

[**0016**] Moreover, it is more desirable to be formed with at least any one among the conductor in which the conductive wire is manufactured to the test pin for the earth or the MEMS process.

[**0017**] Moreover, it is desirable that the test pin, adjacent to each other the test pin, or the conductive wire which is formed in one or more outward appearance one sides among the conductive wire and is adjacent is coated on the insulating material for preventing being contacted with the mutual electricity.

[**0018**] Since it prevents the electric signal delivered through the multiple test pins which according to the invention delivers the signal to the checking object semiconductor like the above from being

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interfered in each other the measurement reliability of the checking object semiconductor is improved.

[**0019**] And the correct high frequency property of the checking object semiconductor is measured.

[**0020**] Figure 1 is a cross-sectional view of the probe card which as an example, is the fabrication test equipment of the conventional apparatus for inspection of semiconductor.
Figure 2 is a schematic diagram showing the conventional apparatus for inspection of semiconductor.
Figure 3 is a cross-sectional view showing the apparatus for inspection of semiconductor according to a preferred embodiment of the present invention.
Figure 4 shows the conductive connection means formed in the guide plate of the apparatus for inspection of semiconductor according to a preferred embodiment of the present invention.
Figure 5 is a schematic diagram showing the apparatus for inspection of semiconductor according to a preferred embodiment of the present invention.

[**0021**] It announces that it is natural to feel that the invention which will be the probe card illustrated in the description using the term called the apparatus for inspection of semiconductor specifically illustrates the preferred embodiment of the invention under this with reference to the accompanying drawing in order to make the description simple is included in the moreover, the technical mapping of the invention while being applicable to all apparatus for inspection of semiconductors that are not limited to the probe card and have multiple test pins, the test kit for semiconductor package and PCB testing system etc.

[**0022**] Figure 3 is a cross-sectional view showing the apparatus for inspection of semiconductor according to a preferred embodiment of the present invention. Figure 4 shows the conductive connection means formed in the guide plate of the apparatus for inspection of semiconductor according to a preferred embodiment of the present invention.

[**0023**] Referring to figures 3 and 4, the apparatus for inspection of semiconductor (1) according to a preferred embodiment of the present invention comprises the guide plate (10), the test pin (20), and the conductive wire (30) and conductive connection means (40).

[**0024**] The guide plate (10) includes the cover plate (11), and the fastening member (13) which is combined in the lower part of the cover plate (11) and is combined in the bottom plate (12), and the formation area of the conductive connection means (40) serves to be provided with supporting the test pin (20) which will be described later and conductive wire (30). As to the cover plate (11), multiple first guide holes (11b) and first conductive wire supported holes (11b') are formed

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in one side. As to multiple second guide holes (12b) and second conductive wire supported holes (12b') are formed in one side the cover plate (11) and bottom plate (12).

[**0025**] The cover plate (11) has the first accommodating groove (11a) in one side of bottom the approximately is formed with the disk or the rectangular plate shape. And multiple first guide holes (11b) and first conductive wire supported holes (11b') are formed in one side.

[**0026**] The bottom plate (12) has the second accommodating groove (12a) in the disk corresponding to the cover plate (11) or one side corresponding to the first accommodating groove (11a) it is formed with the rectangular plate shape. And multiple second guide holes (12b) and second conductive wire supported holes (12b') are formed in one side.

[**0027**] And the cover plate (11) as in the above and bottom plate (12) serve to support the test pin (20) which will be described later and conductive wire (30) the formation area of the conductive connection means (40) which will be described later through each upper side or one side of bottom with the providing through the guide hole and conductive wire supported hole.

[**0028**] In the meantime, in the present preferred embodiment, it is illustrated that the guide plate (10) is comprised of the cover plate (11) and bottom plate (12). But the invention is not thus restricted and the guide plate (10) can be formed with one body like the socket housing of the test socket.

[**0029**] The test pin (20) is inserted and arranged in the first guide hole (11b) as approximately, the rod shape in the upper end portion one side and one side of the bottom part is inserted and arranged in the second guide hole (12b) and such test pin (20) the multiple test pin (G) for the earths, and the test pin (S) for the power test pin (P) and signal are atypically arranged on the guide plate (10).

[**0030**] In the meantime, in the present preferred embodiment, the Cobra probe is illustrated to the test pin (20). But the test pin (20) of the invention is not certainly restricted to the Cobra probe and the various probes including the pogo pin, the wire probe etc. can be used it is of course.

[**0031**] The upper end portion one side the conductive wire (30) is inserted and arranged in the first conductive wire supported hole (11b') and one side of the bottom part is inserted and arranged in the second conductive wire supported hole (12b') and it is adjacent near the test pin (S) for the power test pin (P) or the signal and it is arranged.

[**0032**] Moreover, the conductive wire (30) the upper end portion one side is connected to the upper end portion one side of the respective test pin (G) for the earth through the conductive connection

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means (40) which will be described later and one side of the bottom part is connected to one side of the bottom part of the respective test pin (G) for the earth.

[**0033**] It prevents from being interfered in the test pin (S) for power test pin (P) having a different power test pin (P) or the signal delivered through the test pin (S) for the signal such conductive wire (30) provides each power test pin (P) or the shield function of blocking it becomes the case where the electric signal is delivered, and each power test pin (P) or the electromagnetic wave generated in the test pin (S) for the signal with mutual transmission it is circulated with the test pin (S) for the signal or the signal.

[**0034**] Moreover, it is desirable that the insulating material (30a) is coated on the outward appearance one side in order to prevent from being contacted with it is adjacent test pin (20) and when the checking object semiconductor (DUT, device under test) is inspected it is desirable that the lower end portion is formed with length shorter than the lower end portion of the test pin (20) in order to prevent from being contacted with the checking object semiconductor (DUT, device under test).

[**0035**] In the present preferred embodiment, the conductive wire (30) is illustrated to the same Cobra probe as the test pin (20). But the conductive wire (30) of the invention is not thus restricted and it can be formed with the conductor manufactured to the MEMS process.

[**0036**] Moreover, it is illustrated that the insulating material (30a) this embodiment is coated on the outward appearance one side of the conductive wire (30). But it is not thus restricted and the insulating material (30a) can be formed on the outward appearance one side of the test pin (20).

[**0037**] Comprises the conductive connection means (40) silver conductive bottom layer (40a) and conductive trace (40b).

[**0038**] The conductive material is coated on one side of bottom plate (12) corresponding to the second guide hole (12b) in which the lower end portion of the test pin (G) for one side and the earth are inserted and the second conductive wire supported hole (12b') in which the lower end portion of the conductive wire (30) is inserted of cover plate corresponding to the first guide hole (11b) in which the conductive layer (40a) is inserted with the upper end portion edge of the test pin (G) for the earth and the first conductive wire supported hole (11b') inserted with the upper end portion edge of the conductive wire (30) and one side is formed. Up and down end part one side of the test pin (G) for the earth and conductive wire (30) are contacted and the lower end portion liver of the lower end portion of the test pin (G) for the upper end portion of the upper end portion of the test pin (G) for the contacted earth and conductive wire (30) or the earth and conductive wire (30) are electrically connected through the conductive trace (40b).

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[**0039**] It is formed on the surface of the guide plate (10), in other words, the upper side of the upper side of the cover plate (11) or one side of bottom and bottom plate (12) or one side of bottom using the conductive material and the conductive trace (40b) as shown in FIG. 4 connects electrically the conductive layer (40a) liver. In that way the test pin (G) for the earth and the conductive wire (30) contacted with the conductive layer (40a) serves to be electrically connected.

[**0040**] The conductive trace (40b) as in the above is formed in the upper side or one side of bottom of the cover plate (11) and the conductive layer (40a) touching with the upper end portion edge of the test pin (G) for the earth and the conductive layer (40a) liver touching with the upper end portion edge of the conductive wire (30) are electrically connected and the upper side is formed in the upper side or one side of bottom of the bottom plate (12) and the conductive layer (40a) in which the lower end portion of the test pin (G) for the earth is contacted and the conductive layer (40a) liver in which the lower end portion of the conductive wire (30) is contacted are electrically connected and the test pin (G) for the earth and conductive wire (30) or the conductive wire (30) liver serves to be electrically connected.

[**0041**] Hereinafter, referring to the figure, the operation of the apparatus for inspection of semiconductor (1) according to a preferred embodiment of the present invention decides to look into.

[**0042**] Figure 5 is a schematic diagram showing the apparatus for inspection of semiconductor according to a preferred embodiment of the present invention.

[**0043**] Referring to Figure 5, the apparatus for inspection of semiconductor (1) according to a preferred embodiment of the present invention at least one conductive wire (30) is arranged in the test pin (S) around for the power test pin (P) or the signal and it is connected to the upper end portion of the test pin (G) for it is adjacent earth and it is connected to the lower end portion of the test pin (G) for it is adjacent earth.

[**0044**] It prevents the conductive wire (30) as in the above from being interfered in the test pin (S) for power test pin (P) having a different power test pin (P) or the electric signal delivered through the test pin (S) for the signal the shield function of blocking it becomes the power test pin (P) or the case where the electric signal is delivered through the test pin (S) for the signal, and each power test pin (P) or the electromagnetic wave generated in the test pin (S) for the signal with mutual transmission is provided or the signal.

[**0045**] Therefore, the measurement reliability of the measured checking object semiconductor (DUT, device under test) is improved through the apparatus for inspection of semiconductor (1) of the invention.

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[**0046**] The invention was explained in connection with the above-mentioned preferred embodiments. However it is possible to change as various corrections without deviating from the gist and range of the invention. Therefore, such correction or the deformation in which the attached patent claim belongs to the gist of the invention will be included.

[**0047**] 1: apparatus for inspection of semiconductor 10: guide plate.
11: cover plate 11a: first accommodating groove.
11b: first guide hole 11b': first conductive wire supported hole.
12: bottom plate 12a: second accommodating groove.
12b: second guide hole 12b': second conductive wire supported hole.
13: fastening member 20: test pin.
30: conductive wire 30a: insulating material.
40: the conductive connection means 40a: conductive layer.
40b: conductive trace.

1. The apparatus for inspection of semiconductor, comprising: the multiple guide holes in one side, and the conductive connection means connecting electrically the test pin for the earth and conductive wire among the multiple test pins; the power test pin among the multiple test pins or at least one conductive wire arranged in the test pin around for the signal it is inserted and set up in the conductive wire supported hole in which the lower part is electrically contacted with the checking object semiconductor; the multiple test pins it is inserted and set up in the guide hole in which the conductive wire supported hole is formed; the guide plate.
2. As for claim 1, the apparatus for inspection of semiconductor which is formed in the side of the surface of the guide plate; at least one conductive layer; and comprises the conductive trace connecting the conductive layer liver in which the test pin for the earth and conductive wire is contacted wherein the conductive connection means is contacted to one side of the test pin for the earth and conductive wire it is formed in the inner surface one side of the conductive wire supported hole in which the inner surface one side and conductive wire of the guide hole are inserted in which at least one test pin for the earth among the multiple guide holes is inserted.
3. The apparatus for inspection of semiconductor connecting the conductive layer liver in which one side of the bottom part of the conductive wire and conductive layer is contacted of claim 2, wherein the guide plate comprise at least one second guide hole in one side and the bottom plate in which the second conductive wire supported hole is formed it is combined in the lower part of the cover plate; the cover plate in which at least one first guide hole and the first conductive wire supported hole are formed in one side, and the conductive trace connects; is formed in the upper side or one side of bottom of the bottom plate; and one side of the bottom part of the test pin for the earth is contacted the conductive layer in which the upper end portion one side of the test pin for the earth is contacted the conductive

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layer are formed in the upper side or one side of bottom of the cover plate and the conductive layer liver in which the upper end portion one side of the conductive wire is contacted.

4. As for claim 1, the apparatus for inspection of semiconductor formed with at least any one among the conductor wherein the conductive wire is manufactured to the test pin for the earth or the MEMS process.
5. As for claim 1, the test pin, adjacent to each other the test pin, which is adjacent it is formed in one or more outward appearance one sides among the conductive wire or the apparatus for inspection of semiconductor in which the conductive wire of the insulating material for preventing being contacted is coated to the mutual electricity.

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Milano, September 20, 2021

Your ref.: ***17825770.5 - 1010***

Our ref.: ***TEC076WEP/BF/TS***

Re: EP Application No. ***17825770.5*** *in the name of* ***TECHNOPROBE S.p.A.***

Answer to Communication pursuant to Art. 94(3) EPC dated May 20, 2021

Dear Sirs,

with reference to the Office Action issued on May 20, 2021, in connection with the above-identified patent application, the Applicant would like to submit the following amendments and remarks.

1. Amendments

The Applicant wishes to proceed the examination with a new set of claims herewith enclosed. The Applicant has amended the claims in order to better point out and distinctly claim the present invention. Care has been taken during revision to comply with the requirements of Art. 123(2) EPC.

In particular, previously filed claim 1 has been amended to specify that the probes of the various group are "configured to receive and carry only" *the indicated signal.*

The description text of the present application directly and unambiguously discloses that the probes of the first group are configured to receive and carry only ground signals, as well as that the probes of the second group are configured to receive and carry only power signals, see for example page 13, lines 12-27, of the description text of the application as originally filed, as well as page 14, line 31, and page 15, lines 1-10, in relation to the first group. In relation to the second group, see for example page 15, lines 11-27 of the description text. According to the description text, these groups are therefore well distinguished and carry different signals, with no ambiguity. In other words, from the description text of the application as originally filed, it is

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clear that no other use for the first group is envisaged, as well as no other use for the second group in envisaged, meaning that the respective probes have specific connections to receive and carry only the indicated signals. See also the general statement at page 11, lines 7-20, of the description text.

Moreover, claim 1 now specifies that the guide including the conductive portions is a lower guide or an intermediate guide "when testing the device under test", *see for example page 20, lines 4-7, of the description text of the present application. Support may also be found in the figures of the present application, showing that the guides 40 and 41 are the lower guide and the intermediate guide, respectively, when the testing head 20 tests the devices on the wafer 27.*

All the remaining claims have been left unchanged.

The annexes include the new set of claims. Marked-up pages are included for the Examiner's convenience.

*** ** * ** ***

2. Remarks

In the Written Opinion, the subject-matter of previously filed claim 1 of the present application has been considered as lacking an inventive step in view of the teachings of document D2 (i.e. Korean patent n. KR 101 421 051 B1).

The Applicant respectfully disagrees with the Examiner's opinion and believes that the present application is new and involves an inventive step over the cited prior art for the following reasons. The Applicant has also amended the claims in order to further distinguish the patent application in re from the cited prior art.

As already noted, document D2 discloses a probe head equipped with ground probes and auxiliary probes (called "conductive wires", reference number 30) which surround signal or power probes, the ground probes being short-circuited together with the auxiliary probes by a conductive layer on the guide. The conductive layer of D2 connects to each other only ground probes, while the power probes are not connected to each other and are surrounded by the short-circuited ground probes. Document D2 does not even suggest that the power probes could be connected to each other. Rather, the configuration of D2 teaches away the skilled man from the claimed invention, since the power probes are only disclosed as surrounded by auxiliary probes, just like the signal probes.

The amendments introduced into claim 1 make clear that the probes of the first group carry ground signals only and the probes of the second group carry power signals only, so that these groups carry different types of respective signals. The skilled man clearly recognizes that the probes of the various groups are not simply able to, but actually carry only one kind of signal, so that the present application is clearly distinguished from the prior art.

The claimed configurations allows obtaining all the advantages recited in our previously filled reply letter. The common ground planes help in reducing the noise due to ground probes, as well as the common power planes help in reducing the noise due to power probes (it is in fact observed that a power distribution behaves like a ground distribution). Using the wording of amended claim 1, by sharing the ground paths via the first conductive

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portion 30' and by sharing the power paths via the second conductive portion 30'', the noise of both signals is reduced; since the DUT is sensitive to both the ground and power noise, the testing, in particular at high frequencies, is improved thanks to the solution of the present application. The use of a common ground plane and of a common power plane arranged as close as possible to the DUT (i.e. on the lower/medium guide, as claimed in claim 1) helps in solving this issue. In this way, the various ground/power probes (i.e. probes of a same domain) are short-circuited by the conductive portions near to the DUT and not on the PCB, improving the electrical performances and also reducing inductance loops, thus without transporting the relative signal of the test equipment. As a specific example, common metal power planes help in reducing the inductance loops and the equivalent resistance of the system. The use of common power planes also reduces the common mode noise, as disclosed in the specification.

Document D2 does not disclose nor suggest the above-mentioned distinguishing features of the present application, and the skilled man, when faced with the technical problem of the present invention, would not have found therein any hints leading him to the subject matter of amended claim 1. In document D2 there is no suggestion of short-circuiting different groups of probes by means of different conductive portions; in other words, there is no suggestion of using common metal planes for ground and power probes, and the power probes are never short-circuited. Therefore, by following the teachings of D2, the skilled man would be prompted to connect to each other only ground probes, without any hint towards the solution of the present application.

Regarding document D3 (i.e. US 2014/0197860 A1), it is newly respectfully remarked that in this document there is no suggestion of a first group and a second group carrying different signals. Document D3 provides that only power probes are connected to the diverting circuit, and there is no suggestion that other different probes could be connected to each other. Moreover, the conductive branches of D3 are formed on both lower and upper guide, and not only on lower/intermediate guide as in the present application.

In D3 there is no mention of the technical effect of reducing noise, and this document only focuses about the problem of probe burning, so that the skilled man would not be motivated to combine this document with D2.

For all these reasons, the skilled man, starting from D2 and facing the problem of improving the frequency performances of a testing head, would not consider D3 in order to obtain the invention as claimed in amended claim 1, and no motivation for combination is provided in the prior art. In fact, the problem of improving frequency performances by connecting power probes is never mentioned in the prior art documents and there is no suggestion of different probe groups. All these documents disclose that one kind of probes are connected to each other, and do not give any suggestion of short-circuiting different groups of probes by means of respective different conductive portions in order to reduce noise.

Moreover, regarding document D4, (i.e. WO 2012/106220 A1), the skilled man would never consult this document. In particular, D4 discloses a socket for an integrated circuit and the layers of D4 are not used to improve the frequency performances of the system, as instead provided in the present application, but only for setting a plurality of power sources in the socket. As already noted, the skilled man, facing the problem tied to the frequency performances of a probe card, would thus not consider D4 in order to obtain the invention disclosed in the present application, as the aim of the present application is reducing noise which is achieved by arranging a short-circuit for the ground and power

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probes on the lower guide of the testing head. The embodiments of D4 would not solve the problem of the present application as they will not help in reducing the noise and the improvement of the frequency performances is not even mentioned in such document. The socket of D4 is not comparable to a testing head comprising a lower/medium guide adapted to house a plurality of contact probes, as instead claimed in the patent application in re. In particular, the layers of D4 are not formed on a guide of a testing head, in particular on a lower/intermediate guide, which is fundamental for reducing noise

For all the above reasons, it is thus concluded that claim 1 of the present application is endowed with the required inventive step under Art. 56 EPC, with respect to the cited document, taken alone or in combination with each other.

*** ** * ** ***

3. <u>Conclusions</u>

In view of the above amendments and arguments, it is believed that the present patent application meets all the requirements of the European Patent Convention and a favorable Examiner's decision in this respect is hereby solicited.

Should the Examining Division be of a different opinion, an informal interview or oral proceedings under Art. 116 EPC by Videoconference are hereby respectfully requested.

Many thanks and best regards.

Yours Sincerely,
The Representative
Barbara Ferrari

Encl.: new set of claims;
marked-up pages

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Europäisches Patentamt
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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17825770.5
Applicant's or representative's reference	TEC076WEP

	Description of document	Original file name	Assigned file name
1	Reply to examination report	TEC076WEP-reply office action.pdf	EXRE3-1.pdf
2	Amended claims (clean copy)	TEC076WEP-amended claims clean.pdf	CLMS-1.pdf
3	Amended claims with annotations	TEC076WEP-amended claims marked.pdf	CLMS-HWA-1.pdf

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**Milano**
Date:	**20 September 2021**
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CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41) provided with a plurality of guide holes (40h, 41h), and a plurality of contact elements (21', 21", 21"') housed in said guide holes (40h, 41h), each of said contact elements (21', 21", 21"') comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), wherein said at least one guide (40, 41) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41') of said guide holes (40h, 41h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41') of said guide holes (40h, 41h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41") of said guide holes (40h, 41h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41") of said guide holes (40h, 41h), wherein the contact elements of a same group are adapted to carry a same type of signal, wherein the contact elements of different groups are adapted to carry different types of respective signals, and wherein said first contact elements (21') housed in said first group (40', 41') of said guide holes (40h, 41h) are configured to receive and carry only ground signals, and said second contact elements (21") housed in said second group (40", 41") of said guide holes (40h, 41h) are configured to receive and carry only power signals, and wherein said guide including the conductive portions (30', 30") is a lower guide (40) or an intermediate guide (41) of the testing head (20) when testing the device under test integrated on the semiconductor wafer.

2. The testing head (20) according to claim 1, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41), and the other one of said first and second conductive portion (30", 30') is formed on an opposite

face (FB, FA; FD, FC) of said at least one guide (40, 41).

3. The testing head (20) according to claim 1 or 2, characterized in that said at least one conductive portion (30', 30", 30'") is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

4. The testing head (20) according to claim 3, characterized in that said at least one guide (40, 41) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

5. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

6. The testing head (20) according to any one of the claims from 1 to 4, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said

first conductive portion (30') and said second conductive portion (30"), said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

7. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30"') that includes and electrically connects the holes of a third group (40"', 41"') of said guide holes (40h, 41h) to each other, said third group (40"', 41"') housing third contact elements (21"').

8. The testing head (20) according to claim 7, characterized in that said third contact elements (21"') housed in said third group (40"', 41"') of said guide holes (40h, 41h) are adapted to carry input/output signals between the device under test and a test equipment.

9. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') covers at least one portion (40'W, 40"W , 40"'W; 41'W, 41"W, 41"'W) of an inner surface of each guide hole of said group (40', 40", 40"'; 41', 41", 41"') of said guide holes (40h, 41h).

10. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21"') are contact probes.

11. The testing head (20) according to any one of the claims from 1 to 4, characterized in that said contact elements (21', 21", 21"') are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1) being apt to abut onto said at least one guide (40), the electrical connection between said contact elements (21', 21", 21"') and said at least one conductive portion (30', 30", 30"') being a pressing contact through said surface (S1).

12. The testing head (20) according to any one of the preceding claims,

characterized in that said at least one guide (40, 41) comprises at least one common pad (36', 36", 36"') connected to said at least one conductive portion (30', 30", 30"') by means of a conductive track (37', 37", 37"').

13. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41).

14. The testing head (20) according to any one of the claims from 1 to 12, characterized in that said at least one conductive portion (30', 30", 30"') covers a face of said at least one guide (40, 41), said at least one conductive portion (30', 30", 30"') electrically connecting the holes of said at least one group (40', 41'; 40", 41"; 40"', 41"') of said guide holes (40h, 41h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41'; 40", 41"; 40"', 41"') are formed.

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h) apt to house a single contact element, said at least one guide (40, 41) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

16. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41).

17. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that

electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21'"), said contact elements included in said respective groups being adapted to carry a same type of signal.

18. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41).

CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41) provided with a plurality of guide holes (40h, 41h), and a plurality of contact elements (21', 21", 21"') housed in said guide holes (40h, 41h), each of said contact elements (21', 21", 21"') comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), wherein said at least one guide (40, 41) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41') of said guide holes (40h, 41h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41') of said guide holes (40h, 41h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41") of said guide holes (40h, 41h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41") of said guide holes (40h, 41h), wherein the contact elements of a same group are adapted to carry a same type of signal, wherein the contact elements of different groups are adapted to carry different types of respective signals, and wherein said first contact elements (21') housed in said first group (40', 41') of said guide holes (40h, 41h) are configured~~adapted~~ to receive and carry only ground signals, and said second contact elements (21") housed in said second group (40", 41") of said guide holes (40h, 41h) are configured~~adapted~~ to receive and carry only power signals, and wherein said guide including the conductive portions (30', 30") is a lower guide (40) or an intermediate guide (41) of the testing head (20) when testing the device under test integrated on the semiconductor wafer.

2. The testing head (20) according to claim 1, characterized in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41), and the other one of said first and second conductive portion (30", 30') is formed on an opposite

face (FB, FA; FD, FC) of said at least one guide (40, 41).

3. The testing head (20) according to claim 1 or 2, characterized in that said at least one conductive portion (30', 30", 30'") is separated from further conductive portions and/or is locally interrupted by at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

4. The testing head (20) according to claim 3, characterized in that said at least one guide (40, 41) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

5. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).

6. The testing head (20) according to any one of the claims from 1 to 4, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said

first conductive portion (30') and said second conductive portion (30"), said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41).

7. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30"') that includes and electrically connects the holes of a third group (40"', 41"') of said guide holes (40h, 41h) to each other, said third group (40"', 41"') housing third contact elements (21"').

8. The testing head (20) according to claim 7, characterized in that said third contact elements (21"') housed in said third group (40"', 41"') of said guide holes (40h, 41h) are adapted to carry input/output signals between the device under test and a test equipment.

9. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') covers at least one portion (40'W, 40"W , 40"'W; 41'W, 41"W, 41"'W) of an inner surface of each guide hole of said group (40', 40", 40"'; 41', 41", 41"') of said guide holes (40h, 41h).

10. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21"') are contact probes.

11. The testing head (20) according to any one of the claims from 1 to 4, characterized in that said contact elements (21', 21", 21"') are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1) being apt to abut onto said at least one guide (40), the electrical connection between said contact elements (21', 21", 21"') and said at least one conductive portion (30', 30", 30"') being a pressing contact through said surface (S1).

12. The testing head (20) according to any one of the preceding claims,

characterized in that said at least one guide (40, 41) comprises at least one common pad (36', 36", 36"') connected to said at least one conductive portion (30', 30", 30"') by means of a conductive track (37', 37", 37"').

13. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30"') is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41).

14. The testing head (20) according to any one of the claims from 1 to 12, characterized in that said at least one conductive portion (30', 30", 30"') covers a face of said at least one guide (40, 41), said at least one conductive portion (30', 30", 30"') electrically connecting the holes of said at least one group (40', 41'; 40", 41"; 40"', 41"') of said guide holes (40h, 41h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41'; 40", 41"; 40"', 41"') are formed.

15. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h) apt to house a single contact element, said at least one guide (40, 41) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

16. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41).

17. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that

electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21'"), said contact elements included in said respective groups being adapted to carry a same type of signal.

18. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41).

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	10210416
Application number	EP17825770.5
Date of receipt	20 September 2021
Receiving Office	European Patent Office, The Hague
Your reference	TEC076WEP
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (1 p.) CLMS-1.pdf\TEC076WEP-amended claims clean.pdf (5 p.) ep-sfd-request.xml EXRE3-1.pdf\TEC076WEP-reply office action.pdf (4 p.) CLMS-HWA-1.pdf\TEC076WEP-amended claims marked.pdf (5 p.)
Submitted by	CN=Barbara Ferrari 6913
Method of submission	Online
Date and time receipt generated	20 September 2021, 16:41 (CEST)
Message Digest	5D:52:15:A3:11:E6:2E:47:F5:BE:72:D8:8D:FC:A6:23:0E:97:B1:81

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European Patent Office
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Letter accompanying subsequently filed items

Representative:
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10958 Berlin
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Tel. +49(0)30 25901-0 | Fax -840

The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17825770.5
Applicant's or representative's reference	TEC076WEP

Request:

- Enquiry as to the processing of the file

	Description of document	Original file name	Assigned file name
1	Enquiry as to the processing of the file – electronically generated		EPF1012.PDF

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**Milano**
Date:	**21 September 2022**
Signed by:	**Barbara Ferrari 6913**
Representative name:	**Barbara FERRARI**
Capacity:	**(Representative)**

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Enquiry as to the processing of the file

I/we hereby enquire when the EPO will deliver the (supplementary) European search report / next communication[1]

for application/patent 17825770.5

[1] OJ EPO 2016, A66

Signatures

Place:	**Milano**
Date:	**21 September 2022**
Signed by:	**Barbara Ferrari 6913**
Representative name:	**Barbara FERRARI**
Capacity:	**(Representative)**

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	11324460	
Application number	EP17825770.5	
Date of receipt	21 September 2022	
Receiving Office	European Patent Office, The Hague	
Your reference	TEC076WEP	
Applicant	All applicants as on file	
Documents submitted	package-data.xml epf1038.pdf (1 p.)	ep-sfd-request.xml epf1012.pdf (1 p.)
Submitted by	CN=Barbara Ferrari 6913	
Method of submission	Online	
Date and time receipt generated	21 September 2022, 11:45 (CEST)	
Message Digest	49:FA:E4:A7:5D:05:27:38:35:2C:2C:82:B2:41:23:A5:BA:E1:38:FD	

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Questions about this communication?
Contact Customer Services at www.epo.org/contact

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Date
06.10.2022

Reference	Application No./Patent No.
TEC076WEP	17825770.5 - 1001 / 3555638
Applicant/Proprietor	
Technoprobe S.p.A	

Communication in response to your enquiry received on 21.09.22

☒ The EPO will be able to supply a communication within 06 month(s).

☐ Having regard to the current workload, the EPO will not be able to supply a communication within the next 12 months.

☐ Reference is made to the telephone consultation that took place on .

If the proposed time frame does not meet your needs, please contact the responsible examiner or the director:

Primary Examiner (substantive examination)

Name: Hijazi, Ali
Tel.: +49 (0)89 2399 - 7782

Director

Name: Gex-Collet A
Tel.: +49 (0)89 2399 - 4951

General information:
If you wish your application to be examined more quickly than the time frame indicated above, your attention is drawn to the possibility of requesting accelerated examination under the "PACE" programme of the EPO (OJ EPO 2015, A93). However, if a request for accelerated examination has already been filed and the application has been removed from the PACE programme, a second request for accelerated examination can no longer be processed (OJ EPO 2015, A93, point 4).

For the Examining Division

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Tel: +49 89 2399 - 7782

Application No.	Ref.	Date
17 825 770.5 - 1001	TEC076WEP	17.04.2023
Applicant Technoprobe S.p.A		

Communication pursuant to Article 94(3) EPC

The examination of the above-identified application has revealed that it does not meet the requirements of the European Patent Convention for the reasons enclosed herewith. If the deficiencies indicated are not rectified the application may be refused pursuant to Article 97(2) EPC.

You are invited to file your observations and insofar as the deficiencies are such as to be rectifiable, to correct the indicated deficiencies within a period

of 4 months

from the notification of this communication, this period being computed in accordance with Rules 126(2) and 131(2) and (4) EPC. One set of amendments to the description, claims and drawings is to be filed within the said period on separate sheets (R. 50(1) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

Failure to comply with this invitation in due time will result in the application being deemed to be withdrawn (Art. 94(4) EPC).

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Hijazi, Ali
Primary Examiner
For the Examining Division

Enclosure(s): 5 page/s reasons (Form 2906)
US-20150198632-A1

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The examination is being carried out on the **following application documents**

Description, Pages

1-3, 5-32	as published
4	as annexed to the Int. Prel. Examination Report

Claims, Numbers

1-18	filed in electronic form on	20-09-2021

Drawings, Sheets

1/13-13/13	as published

1 The following document has been found during a top-up search and is cited by the Examiner . A copy of the document is annexed to the communication.

D5 US 2015/198632 A1 (KIM IL [KR]) 16 July 2015 (2015-07-16)

2 State of procedure

The letter of reply received on 20-09-2021 was carefully studied. It appears that the objections of the previous communication were not resolved by the arguments/amendments as submitted, see the explanations below.

3 Amendments.

3.1 "are configured ~~adapted~~ to receive and carry only ground signals / power signals"

The quoted passages from the Applicant (p. 11 and 13-15) do not appear to disclose such definition in the manner it is yet claimed, see especially the word "only" which throw doubts with regard to the provisions of Article 123(2) EPC. It is furthermore difficult to understand how a contact element can be "configured" in such a manner as to accept only a specific type of signal (ground or power here): depending on the connection to a power supply or to a signal generator any kind of signals can be apply to such a contact element.

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It is furthermore doubtful that the contact elements as such are configured to "receive" ground/power signals in the sense that this would imply a structural difference: the embodiment of Fig. 7 (pogo pins) does not show any such structural difference, all the pogo pins seem identical.

In any case, as already mentioned under point 2.1.2 of the last communication, these definitions relate to the (potential) use of the testing head and do not lead to a clear structural definition as required for an apparatus claim, contrary to Article 84 EPC.

It is furthermore noted that the embodiment of Fig. 7 (directed to pogo pins) does not appear to disclose any structural difference between the pins of the three groups (power, ground and signals). This clearly show that the claimed testing head cannot be interpreted as implying some structural differences between the contact elements as such but only that some of these contact elements are electrically grouped and may later on be connected to a tester in order to apply power, ground and testing signals (i.e. should be merely suitable for such use).

All in all, these amendments do not appear to change anything to the discussion on patentability and it is suggested to revert to the original wording.

3.2 "when testing the device under test integrated on the semiconductor wafer"

This amendment only took part of the quoted sentence of p. 20, l. 4-7 and does not mention that the guides are then closer to the DUT (when testing) leading also to some doubts with regard to Article 123(2) EPC and Article 84 EPC.

See also the last sentence of point 2.1.2: "That the lower guide should correspond to the part closer to the DUT is not specified in claim 1". By not knowing how the DUT is positioned, it cannot be determined which guide is "lower" or not. It is for instance known to have testing apparatus where the DUT is positioned in the vertical direction: in such case there would be no lower guide.

4 Novelty, inventive step.

4.1 Claim 1.

4.1.1 Considering D5.

D5 is a similar document as D2 but provides some more details on the grouping of probes. D5 discloses:

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A testing head (e.g. Fig. 2) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head comprising at least one guide (11, 12) provided with a plurality of guide holes (11b, 12b), and a plurality of contact elements (30) housed in said guide holes, each of said contact elements comprising a body that extends between a first end portion and a second end portion (see the Figs.), wherein said at least one guide comprises at least one first conductive portion (20, 40) that includes the holes of at least one first group of said guide holes (paragraphs 0050-0052) and electrically connects a corresponding first group of said contact elements (the ground G) housed in said at least one first group of said guide holes, and at least one second conductive portion that includes the holes of at least one second group of said guide holes and electrically connects a corresponding second group of said contact elements housed in said at least one second group of said guide holes (the power P) wherein the contact elements of a same group are adapted to carry a same type of signal, wherein the contact elements of different groups are adapted to carry different types of respective signals (paragraph 0051), and wherein said first contact elements housed in said first group of said guide holes are configured to receive and carry only ground signals, and said second contact elements housed in said second group of said guide holes are configured to receive and carry only power signals (see e.g. fig. 5), and wherein said guide including the conductive portions is a lower guide (see paragraph 0052, both upper and lower guide are envisaged) or an intermediate guide of the testing head when testing the device under test integrated on the semiconductor wafer.

It appears therefore that the subject-matter of claim 1 is not new in view of D5 (Article 54(1), (2) EPC.

As far as the intermediate guide is concerned, positioning (alternatively or in addition) the conductive layer on such guide is a mere obvious constructional detail for the skilled person not involving an inventive step either (Article 56 EPC). It is noted that testing head having more than two guides for vertical probes are well known to the skilled person.

4.1.2 Considering D2, it is referred to the previous communication, point 2.

The amendments made to present claim 1 do not change the assessment made as it is still argued that the attempted limitation on the contact elements is not clear (see point 3.1 above) and the lower guide of D2 fulfils the definition (even if clarified) that it is the closest to the DUT.

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Concerning the arguments submitted in the last letter of answer the following is noted:

The fact that D2 (the starting point) does not suggest grouping power probes (as far as clear, as already discussed under point 3.1 above and in the last communication) is not relevant to inventive step: what is relevant is whether some teaching may be seen in the available prior art which would lead the skilled person to the claimed subject-matter.

The Applicant further argues about common planes helping in reducing the noise: As mentioned in point 2.1.4 of the last communication, no plane is defined in claim 1. Claim 1 encompasses the case of two times two probes being respectively connected by one line ("portion" to take the wording of the claim) on e.g. the lower guide forming thereby two groups of two probes.

The Applicant further argues that "the conductive branches of D3 are formed on both lower and upper guide, and not only on lower/intermediate guide as in the present application". The claim does not specify that the grouping takes place only in the lower or intermediate guide. The fact that D3 mentions only a grouping of the power probes does not appear to be relevant for the inventive step provided at point 2.1.5 of the last communication (this discussion even interpreting the claim in a more limited manner than justified by its wording).

The Applicant appears also to define the problem to be solved as improving the frequency performance of the testing head of D2. This problem cannot be objectively defined out of the present wording of claim 1 which is still very broad. It is not apparent how two groups of two probes connected by a line on the guide will lead to any significant improvement of the frequency performance. Even if this would be the case, this does not prevent to define another problem if the stated difference allows so. Therefore the problem defined in the last communication, point 2.1.5, is also considered as valid and this line of argumentation is maintained.

Concerning D4, it was not understood why the embodiments of D4 would not solve the problem of the present application as it discloses power and ground planes like discussed in the letter of answer. It appears that the skilled person wishing to implement an embodiment with several power and ground groups in the testing head of D2 would implement the teaching of D4 in the lower guide of D2 without having technical difficulties and without the need of inventive skills.

For all these reasons, the subject-matter of claim 1 also does not involve an inventive step (Article 56 EPC).

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4.1.3 As already mentioned in the last communication, the dependent claims do not appear to be of such nature as to restore novelty or inventive step.

For instance, D5 mentions that pogo pins may be used instead of cobra (paragraph 0040) so that for instance claim 11 does not appear to be new either. As mentioned above having several guides (more than two) like in claims 5 or 6 do not appear to confer an inventive step either,

However, in case the Applicant would take over features of one of these dependent claims as a basis for further prosecution, it is asked to provide a reasoning based on the technical effect which is achieved by the difference between such features and the available documents and the objective problem thereby solved.

5 The Applicant is asked to file a new set of claims taking into account the above objections. When filing the new claims, the Applicant should:

5.1 Bring the description into conformity with the amended claims **(Rule 42(1)(c) EPC)**,

5.2 use the two-part form (**Rule 43(1) EPC**),

5.3 provide the features of the claims with reference signs placed in parentheses in order to increase the intelligibility of the claims (**Rule 43(7) EPC**) and

5.4 should indicate in the letter of reply the difference of the subject-matter of the new independent claim vis-à-vis the state of the art and the significance thereof (e.g.: closest prior art, distinguishing technical features in view of this prior art, problem solved by these distinguishing technical features, unexpected / unforeseeable / surprising effect achieved by these features, further reasons for inventive step).

6 The attention of the Applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (**Article 123(2) EPC**).

In order to facilitate the examination of the conformity of the amended application with the requirements of Article 123(2) EPC, the Applicant is requested to clearly identify the amendments carried out, irrespective of whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (Guidelines H-III, 2.2 and Rule 137(4) EPC).

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BREVETTI & MARCHI

EUROPEAN PATENT & TRADEMARK ATTORNEYS

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C.F./P. IVA 12682390153
R.E.A. MI 1577190

RC Professionale Zurich
95NA0534

European Patent Office
Erhardtstrasse 27
D-80298 Munchen
Germany

FAO: Ms. Monica Gazzoli

Milano, May 25, 2023

Your ref.: **ASSOCIATION NO. 1234**

Our ref.: **EPO ASSOCIATION/bv**

Re: **Transfer of files to the mailbox of Association No. 1234**

Dear Sirs,

We write further to your communication dated May 15, 2023, indicating that the association of professional representatives BOTTI & FERRARI S.p.A. has been registered under number 1234 with effect from 03.05.2023.

We hereby kindly request that all files managed by the associates of BOTTI & FERRARI S.p.A. be transferred from their personal mailbox to the mailbox of the association, with the exception of Ms. Silvia Cataldi.

Ms. Cataldi has recently started working in BOTTI & FERRARI but the applicants of the European Applications for which she is representative have not authorized the transfer of management, which will continue to be under the care of Messrs. BARZANO' & ZANARDO.

Thank you in advance for your kind assistance in this matter.

Sincerely yours,
BOTTI & FERRARI

Rinaldo Ferreccio

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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	00000000.0
Applicant's or representative's reference	Association/bv

	Description of document	Original file name	Assigned file name
1	General enquiry	EPO letter Association.pdf	ENQUIRY-1.pdf

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**Milan, Italy**
Date:	**25 May 2023**
Signed by:	**Rinaldo Ferreccio 6912**
Representative name:	**Rinaldo FERRECCIO**
Capacity:	**(Representative)**

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Questions about this communication?
Contact Customer Services at www.epo.org/contact

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Date
01.06.2023

Reference	Application No./Patent No.
TEC076WEP	17825770.5 - 1001 / 3555638
Applicant/Proprietor	
Technoprobe S.p.A	

Communication of amended entries concerning the representative (R. 143(1)(h) EPC)

As requested, for the above-mentioned European patent application / European patent the entries concerning the representative have been amended as follows:

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The amendment will be recorded in the Register of European Patents.

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For the Examining Division

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Cap. Soc. 500.000 Euro i.v.
C.F./P. IVA 12682390153
R.E.A. MI 1577190

RC Professionale Zurich
95NA0534

EPO
EUROPEAN PATENT OFFICE
D-80298 München
GERMANY

Milano, August 07, 2023

Your ref.: **17825770.5 – 1001**
Our ref.: **TEC076WEP/TS**

Re: EP Application No. **17825770.5** in the name of **TECHNOPROBE S.p.A.**

Answer to Communication pursuant to Art. 94(3) EPC dated April 17, 2023

Dear Sirs,

with reference to the Office Action issued on April 17, 2023, in connection with the above-identified patent application, the Applicant would like to submit the following Amendments and Remarks.

1. Amendments

The Applicant wishes to proceed the Examination with a new set of claims herewith enclosed. The Applicant has amended the claims in order to better point out and distinctly claim the present invention. Care has been taken during revision to comply with the requirements of Art. 123(2) EPC.

First of all, the previously presented amendments have been deleted in order to solve the corresponding issues.

More in particular, the unclear sentence *"wherein said guide including the conductive portions (30', 30") is a lower guide (40) or an intermediate guide (41) of the testing head (20) when testing the device under test integrated on the semiconductor wafer"*, which was previously introduced into claim 1, has been deleted.

Likewise, the objected expression *"configured to receive and carry only [...]"* has been amended to solve the corresponding clarity and added matter issues.

Moreover, claim 1 has been amended to claim that *"the first conductive portion (30') and the second conductive portion (30") are formed on a same face (FA) of the at least one guide (40) and are physically and electrically separated from each other by at least one non-conductive zone (31, 31', 31")".*

Support for this amendment is found for example at page 17, lines 27-31, and page 18, lines 1-7 of the description text as originally filed. See also figure 3B or figure 3C of the application as originally filed.

The remaining claims have been amended to be in accordance with amended claim 1.

The annexes include the new set of claims. Marked-up pages are included for the Examiner's convenience.

*** ** * ** ***

2. Remarks

In the Written Opinion, the subject-matter of previously filed claim 1 of the present application has been considered as lacking novelty and inventive step in view of the cited Documents.

The Applicant respectfully disagrees with the Examiner's opinion and believes that the present application is new and involves an inventive step over the cited prior art for the following reasons. The Applicant has also amended the claims as discussed above in order to further distinguish the patent application in re from the cited prior art.

As already noted in the past replies, according to claim 1 of the present application, the probes of the first group are adapted to carry ground signals and the probes of the second group are adapted to carry power signals, so that these groups carry different types of respective signals. The skilled man clearly recognizes that said probes, which are adapted to carry different signals, are different, as well as that there are different regions of the device dedicated to the different signals. This is clearly stated in the specification as originally filed; see for example page 11, stating that different regions for different signals are identified and that *"in the testing head 20 there are contact elements adapted to carry power and ground signals and contact elements adapted to carry input/output signals towards/from a device under test, those contact elements being distinct from each other and having different physical and mechanical characteristics".*

In any case, in light of the new amendment that has been introduced into claim 1, the cited Documents do not disclose nor suggest that *"the first conductive portion and the second conductive portion are formed on a same face the at least one guide and are physically and electrically separated from each other by at least one non-conductive zone"*, as now claimed in amended claim 1.

Regarding Document D2, it discloses a probe head with ground probes and auxiliary probes (called "conductive wires", reference number 30) which

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surround signal or power probes, the ground probes being short-circuited together with the auxiliary probes by a conductive layer on the guide. The conductive layer of D2 connects to each other only ground probes and there is no suggestion of different conductive portions for different signals on a same face of the guide.

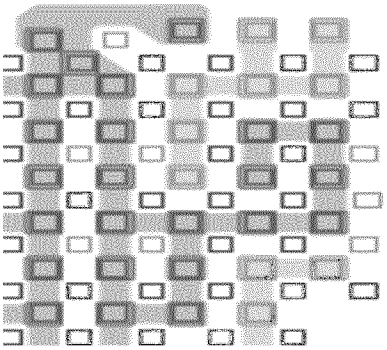
Further, Document D3 provides that only power probes are connected to the diverting circuit, and the different conductive branches are formed on different guides. Also in this case, there is no suggestion of different conductive portions for different signals on a same face of the guide.

Regarding Document D4, the various layers are not formed on a guide of a testing head, and there is no hint about different conductive portions for different signals on a same face of a guide of a testing head. Moreover, in Document D4 the various conductive layers are used to form the so called "C component" with a given capacity, which is different from the present application.

Finally, regarding Document D5, it discloses the possibility of forming different conductive portions but it is completely silent about the possibility of forming said portions for different signals on a same face of the guide.

For all the above reasons, it is thus concluded that claim 1 of the present application is new under Art. 54 EPC, with respect to the cited documents.

It is also observed that the claimed configuration is particularly advantageous and leads to many technical benefits. More in particular, the possibility of forming different conductive portions on a same face of the guide allows to easily arrange said conductive portions in the testing head, following the layout of the device under test (DUT). As previously mentioned, different regions can be identified for different signals, and, according to the present application, different metallizations are formed on the face of the guide.



Many layouts can be easily devised; for example, the layout on the left can be envisaged, including ground and power conductive portions on a same guide.

Specifically, the different colors corresponds to different domains on a face of the guide (e.g., the red color of the figure corresponds to ground domain, while the remaining colors correspond to different power domains).

Therefore, this feature of claim 1 of the present application allows to easily follow the layout of the DUT, forming different conductive domains on the guide corresponding to the domains of the DUT. Then, as stated in our past replies, said conductive portions help in reducing the noise in the carried signals, including eliminating inductance loops and improving performances.

The cited Documents and do not give any suggestion of short-circuiting different groups of probes by means of respective different conductive portions on a same face of the guide.

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For all the above reasons, it is thus concluded that claim 1 of the present application is endowed with the required inventive step under Art. 56 EPC, with respect to the cited document, taken alone or in combination with each other.

*** ** * ** ***

3. Conclusions

In view of the above amendments and arguments, it is believed that the present patent application meets all the requirements of the European Patent Convention and a favorable Examiner's decision in this respect is hereby solicited.

Should the Examining Division be of a different opinion, an informal interview or oral proceedings under Art. 116 EPC by Videoconference are hereby respectfully requested.

Many thanks and best regards.

Yours Sincerely,
The Representative

Tommaso Sala

Encl.: new set of claims; and
marked-up pages

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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17825770.5
Applicant's or representative's reference	TEC076WEP

	Description of document	Original file name	Assigned file name
1	Reply to examination report	TEC076WEP-Reply to Office Action.pdf	EXRE3-1.pdf
2	Amended claims (clean copy)	TEC076WEP-amended claims clean.pdf	CLMS-1.pdf
3	Amended claims with annotations	TEC076WEP-amended claims marked.pdf	CLMS-HWA-1.pdf

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**Milano**
Date:	**10 August 2023**
Signed by:	**Tommaso Sala 76061**
Association:	**BOTTI & FERRARI S.p.A.**
Representative name:	**SALA Tommaso**
Capacity:	**(Representative)**

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CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41) provided with a plurality of guide holes (40h, 41h), and a plurality of contact elements (21', 21", 21"') housed in said guide holes (40h, 41h), each of said contact elements (21', 21", 21"') comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), wherein said at least one guide (40, 41) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41') of said guide holes (40h, 41h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41') of said guide holes (40h, 41h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41") of said guide holes (40h, 41h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41") of said guide holes (40h, 41h), wherein the contact elements of a same group are adapted to carry a same type of signal, wherein the contact elements of different groups are adapted to carry different types of respective signals, and wherein said first contact elements (21') housed in said first group (40', 41') of said guide holes (40h, 41h) are configured to carry ground signals, and said second contact elements (21") housed in said second group (40", 41") of said guide holes (40h, 41h) are configured to carry power signals, and wherein the first conductive portion (30') and the second conductive portion (30") are formed on a same face (FA) of the at least one guide (40) and are physically and electrically separated from each other by at least one non-conductive zone (31, 31', 31").

2. The testing head (20) according to claim 1, characterized in that said at least one conductive portion is locally interrupted by the at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of

signal and/or contact elements which must not be short-circuited.

3. The testing head (20) according to claim 2, characterized in that said at least one guide (40, 41) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

4. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30").

5. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30'") that includes and electrically connects the holes of a third group (40'", 41'") of said guide holes (40h, 41h) to each other, said third group (40'", 41'") housing third contact elements (21'").

6. The testing head (20) according to claim 5, characterized in that said third contact elements (21'") housed in said third group (40'", 41'") of said guide holes (40h, 41h) are adapted to carry input/output signals between the device under test and a test equipment.

7. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") covers at least one portion (40'W, 40"W , 40'"W; 41'W, 41"W, 41'"W) of an inner surface of each guide hole of said group (40', 40", 40'"; 41', 41", 41'") of said guide holes (40h, 41h).

8. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21'") are contact

probes.

9. The testing head (20) according to claim 1, characterized in that said contact elements (21', 21", 21'") are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1) being apt to abut onto said at least one guide (40), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said surface (S1).

10. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

11. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h) apt to house a single contact element, said at least one guide (40, 41) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

12. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21'"), said contact elements included in said respective groups being adapted to carry a same type of signal.

13. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41).

CLAIMS

1. A testing head (20) adapted to verify the operation of a device under test integrated on a semiconductor wafer, said testing head (20) comprising at least one guide (40, 41) provided with a plurality of guide holes (40h, 41h), and a plurality of contact elements (21', 21", 21"') housed in said guide holes (40h, 41h), each of said contact elements (21', 21", 21"') comprising a body (21pr, 21pp) that extends between a first end portion (24) and a second end portion (25), wherein said at least one guide (40, 41) comprises at least one first conductive portion (30') that includes the holes of at least one first group (40', 41') of said guide holes (40h, 41h) and electrically connects a corresponding first group of said contact elements (21') housed in said at least one first group (40', 41') of said guide holes (40h, 41h), and at least one second conductive portion (30") that includes the holes of at least one second group (40", 41") of said guide holes (40h, 41h) and electrically connects a corresponding second group of said contact elements (21") housed in said at least one second group (40", 41") of said guide holes (40h, 41h), wherein the contact elements of a same group are adapted to carry a same type of signal, wherein the contact elements of different groups are adapted to carry different types of respective signals, and wherein said first contact elements (21') housed in said first group (40', 41') of said guide holes (40h, 41h) are configured to ~~receive and~~ carry ~~only~~ ground signals, and said second contact elements (21") housed in said second group (40", 41") of said guide holes (40h, 41h) are configured to ~~receive and~~ carry ~~only~~ power signals, and ~~wherein said guide including the conductive portions (30', 30") is a lower guide (40) or an intermediate guide (41) of the testing head (20) when testing the device under test integrated on the semiconductor wafer~~wherein the first conductive portion (30') and the second conductive portion (30") are formed on a same face (FA) of the at least one guide (40) and are physically and electrically separated from each other by at least one non-conductive zone (31, 31', 31").

~~2. The testing head (20) according to claim 1, characterized in that one of~~

~~said first and second conductive portion (30', 30") is formed on a face (FA, FB; FC, FD) of said at least one guide (40, 41), and the other one of said first and second conductive portion (30", 30') is formed on an opposite face (FB, FA; FD, FC) of said at least one guide (40, 41).~~

~~3~~2. The testing head (20) according to claim 1 ~~or 2~~, characterized in that said at least one conductive portion ~~(30', 30", 30"')~~ ~~is separated from further conductive portions and/or~~ is locally interrupted by the at least one non-conductive zone (31, 31', 31"), so as not to allow an electrical connection between contact elements adapted to carry a different type of signal and/or contact elements which must not be short-circuited.

~~4~~3. The testing head (20) according to claim ~~3~~2, characterized in that said at least one guide (40, 41) comprises at least one coating dielectric portion that covers said at least one non-conductive zone (31, 31', 31").

~~5. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21"'), and in that one of said first and second conductive portion (30', 30") is formed on a face (FA, FB) of said lower guide (40) and the other one of said first and second conductive portion (30", 30') is formed on a face (FC, FD) of said intermediate guide (41).~~

~~6~~4. The testing head (20) according to any one of the preceding claims ~~from 1 to 4~~, characterized in that it comprises at least one lower guide (40), at least one intermediate guide (41), and at least one upper guide (42), said lower guide (40) and said intermediate guide (41) being separated from each other by a first gap (32'), said intermediate guide (41) and said upper guide (42) being separated from each other by a

second gap (32"), each of said guides (40, 41, 42) comprising respective guide holes (40h, 41h, 42h) for the housing of said contact elements (21', 21", 21'"), and in that both said lower guide (40) and said intermediate guide (41) comprise both said first conductive portion (30') and said second conductive portion (30"), ~~said first conductive portion (30') and said second conductive portion (30") being physically and electrically separated from each other by a non-conductive zone (31, 31', 31") of said guides (40, 41)~~.

~~7~~5. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one third conductive portion (30'") that includes and electrically connects the holes of a third group (40'", 41'") of said guide holes (40h, 41h) to each other, said third group (40'", 41'") housing third contact elements (21'").

~~8~~6. The testing head (20) according to claim ~~7~~5, characterized in that said third contact elements (21'") housed in said third group (40'", 41'") of said guide holes (40h, 41h) are adapted to carry input/output signals between the device under test and a test equipment.

~~9~~7. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") covers at least one portion (40'W, 40"W , 40'"W; 41'W, 41"W, 41'"W) of an inner surface of each guide hole of said group (40', 40", 40'"; 41', 41", 41'") of said guide holes (40h, 41h).

~~10~~8. The testing head (20) according to any one of the preceding claims, characterized in that said contact elements (21', 21", 21'") are contact probes.

~~11~~9. The testing head (20) according ~~to any one of the claims from 1 to 4~~to claim 1, characterized in that said contact elements (21', 21", 21'") are pogo pins, said body (21pp) comprising a casing (33) and an elastic member (34) arranged in said casing (33), said casing (33) defining a first surface (S1) and a second surface (S2), at least one of said surfaces (S1)

being apt to abut onto said at least one guide (40), the electrical connection between said contact elements (21', 21", 21'") and said at least one conductive portion (30', 30", 30'") being a pressing contact through said surface (S1).

~~12~~10. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one common pad (36', 36", 36'") connected to said at least one conductive portion (30', 30", 30'") by means of a conductive track (37', 37", 37'").

~~13. The testing head (20) according to any one of the preceding claims, characterized in that said at least one conductive portion (30', 30", 30'") is arranged on a face (FA, FB, FC, FD, FE) of said at least one guide (40, 41) and has a lower area than an area of said face (FA, FB, FC, FD, FE) of said at least one guide (40, 41).~~

~~14. The testing head (20) according to any one of the claims from 1 to 12, characterized in that said at least one conductive portion (30', 30", 30'") covers a face of said at least one guide (40, 41), said at least one conductive portion (30', 30", 30'") electrically connecting the holes of said at least one group (40', 41'; 40", 41"; 40'", 41'") of said guide holes (40h, 41h) to each other, with the exception of areas where guide holes not belonging to said at least one group (40', 41'; 40", 41"; 40'", 41'") are formed.~~

~~15~~11. The testing head (20) according to any one of the preceding claims, characterized in that said at least one guide (40, 41) comprises at least one further conductive portion (30bis), which includes one of said guide holes (40h, 41h) apt to house a single contact element, said at least one guide (40, 41) comprising a further common pad (36bis) connected to said at least one further conductive portion (30bis) by means of a further conductive track (37bis) and/or comprising a conductive track that connects said at least one further conductive portion (30bis) to other conductive portions.

~~16. The testing head (20) according to claim 1, characterized in that said at least one conductive portion (30', 30", 30"') is embedded in said at least one guide (40, 41).~~

~~17~~12. The testing head (20) according to any one of the preceding claims, characterized in that it comprises at least one conductive track (39) that electrically connects at least two conductive portions including and electrically connecting the holes of two respective groups of said guide holes (40h, 41h) to each other and being adapted to contact respective groups of said contact elements (21', 21", 21"'), said contact elements included in said respective groups being adapted to carry a same type of signal.

~~18~~13. The testing head (20) according to any one of the preceding claims, characterized in that it further comprises at least one circuit component (50), preferably a capacitor, which is electrically connected at least to said at least one conductive portion of said at least one guide (40, 41).

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	12328118
Application number	EP17825770.5
Date of receipt	10 August 2023
Receiving Office	European Patent Office, The Hague
Your reference	TEC076WEP
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (1 p.) CLMS-1.pdf\TEC076WEP-amended claims clean.pdf (4 p.) ep-sfd-request.xml EXRE3-1.pdf\TEC076WEP-Reply to Office Action.pdf (4 p.) CLMS-HWA-1.pdf\TEC076WEP-amended claims marked.pdf (5 p.)
Submitted by	CN=Tommaso Sala 76061
Method of submission	Online
Date and time receipt generated	10 August 2023, 16:29 (CEST)
Message Digest	A7:A9:4B:F5:CF:02:DA:2F:D2:58:EC:53:EE:05:40:E6:12:A3:8E:56

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