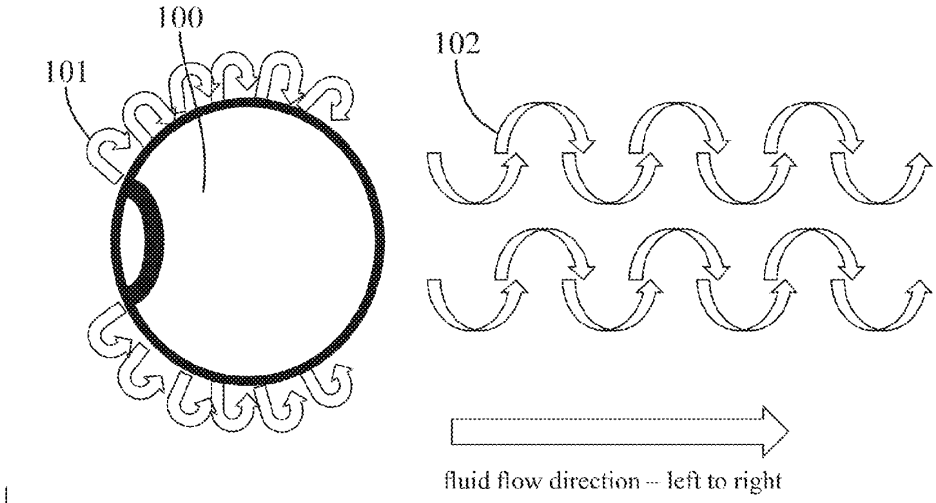

100
101
102
fluid flow direction -- left to right

FIG. 1A

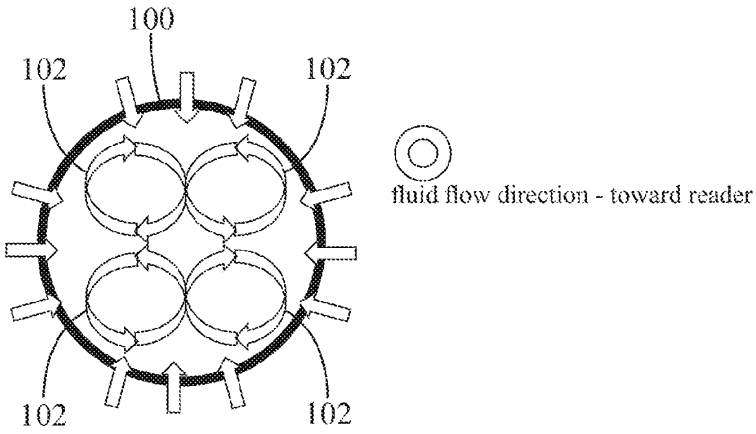

100
102
102
102
102
fluid flow direction - toward reader

FIG. 1B

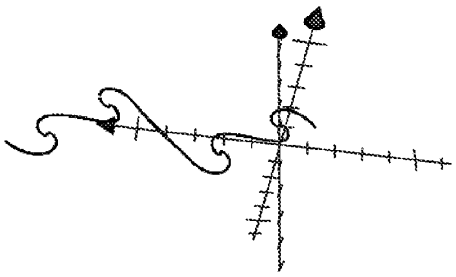


FIG. 2A

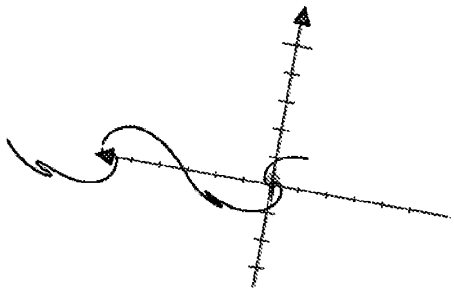


FIG. 2B

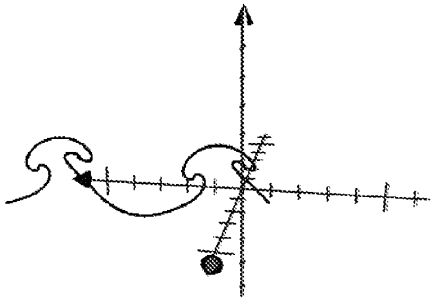


FIG. 2C

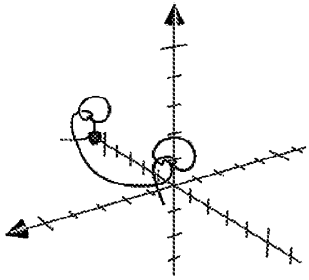


FIG. 2D

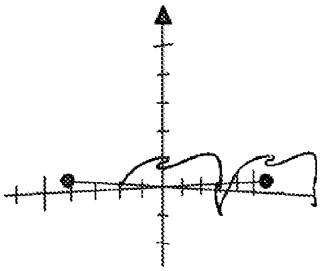


FIG. 2E

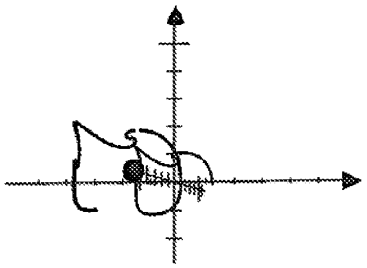


FIG. 2F

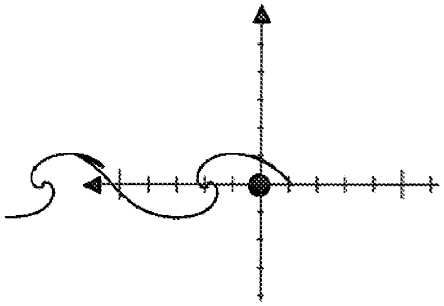


FIG. 2G

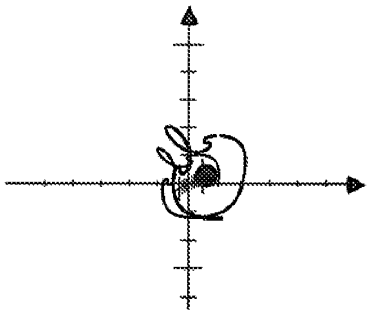


FIG. 2H

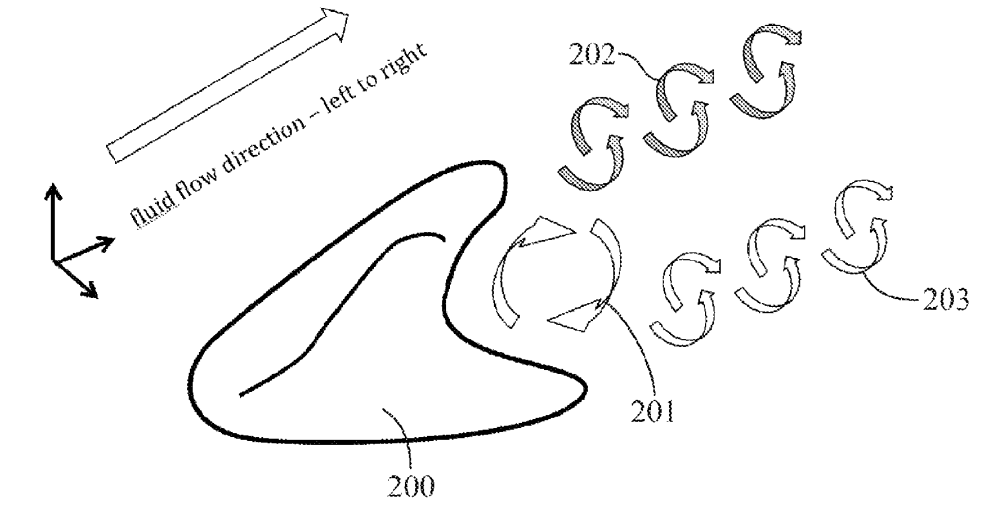

fluid flow direction – left to right
202
203
201
200

FIG. 3A

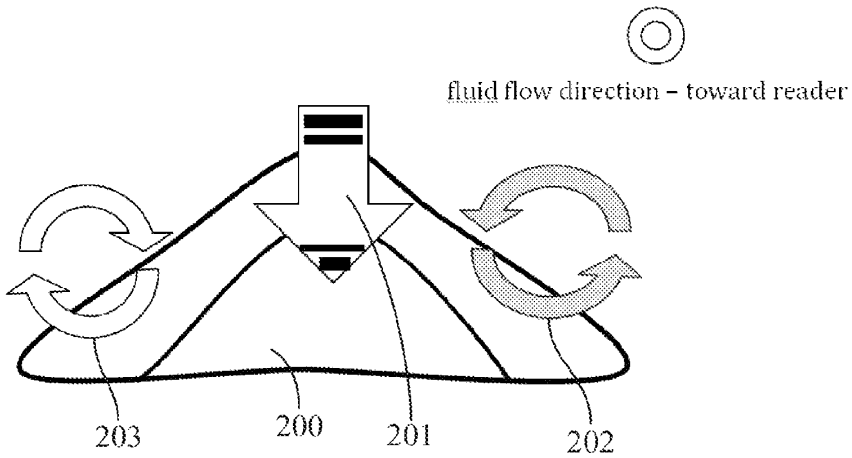

fluid flow direction – toward reader
203
200
201
202

FIG. 3B

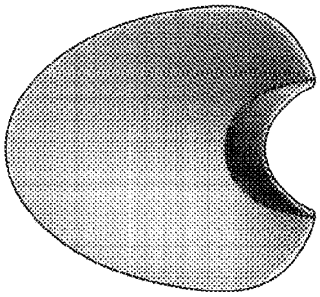


FIG. 4A

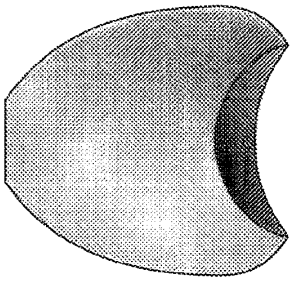


FIG. 4B

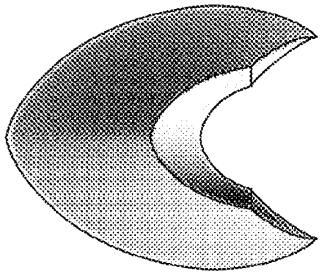


FIG. 4C

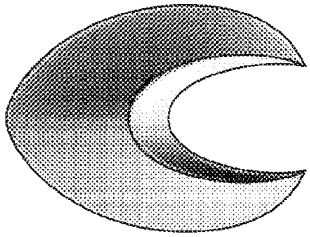


FIG. 4D

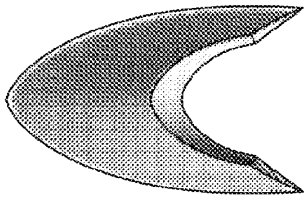


FIG. 4E

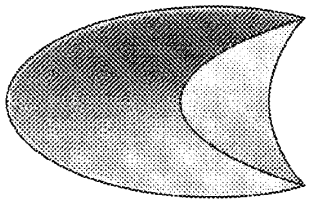


FIG. 4F

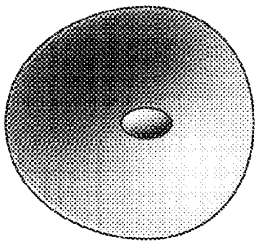


FIG. 4G

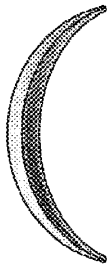


FIG. 4H

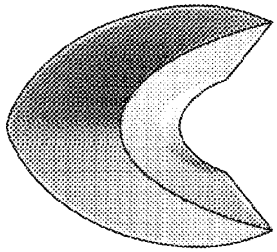


FIG. 4I

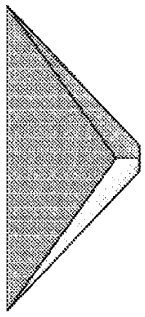


FIG. 5A

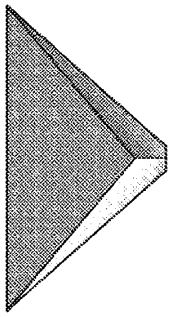


FIG. 5B

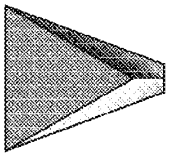


FIG. 5C

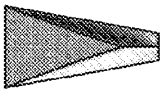


FIG. 5D

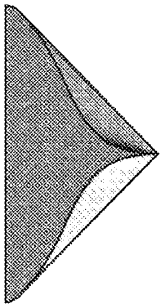


FIG. 5E

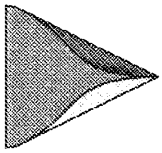


FIG. 5F

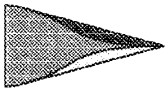


FIG. 5G

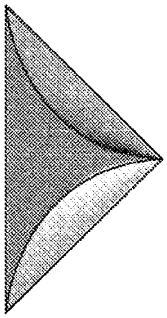


FIG. 5H

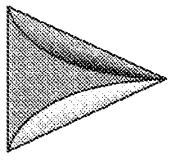


FIG. 5I

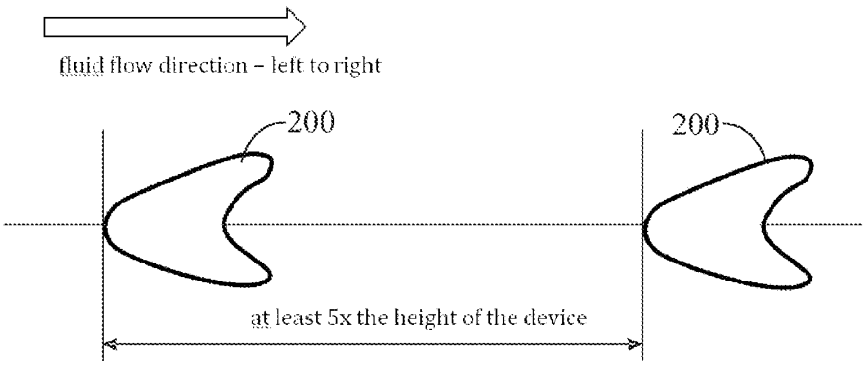

fluid flow direction – left to right
200
200
at least 5x the height of the device

FIG. 6

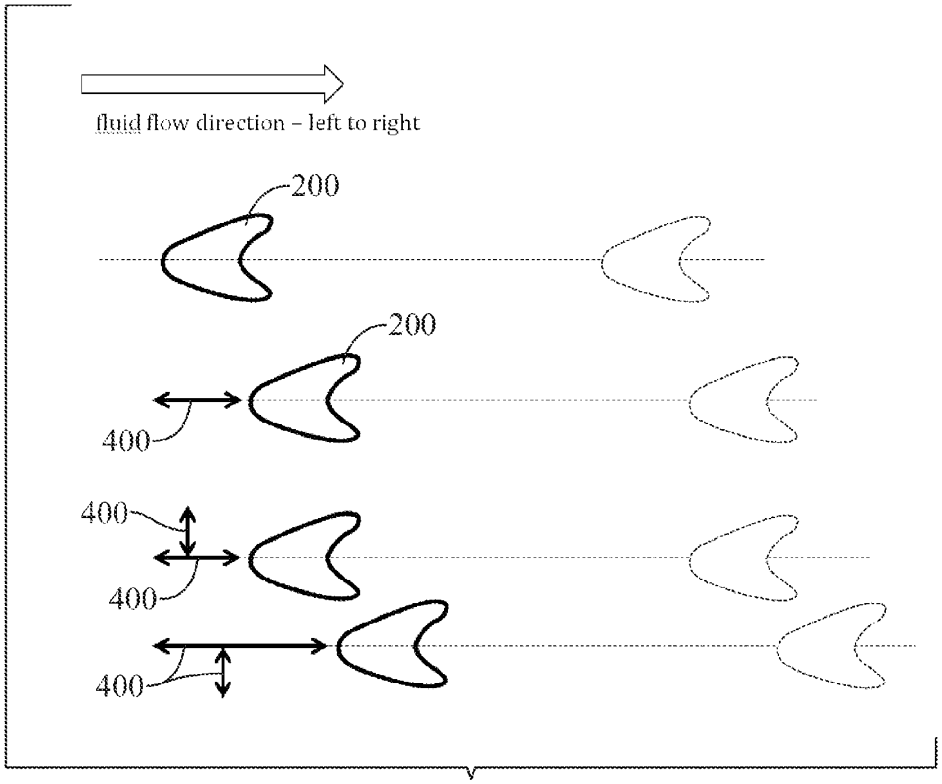

fluid flow direction – left to right
200
200
400
400
400
400

FIG. 7

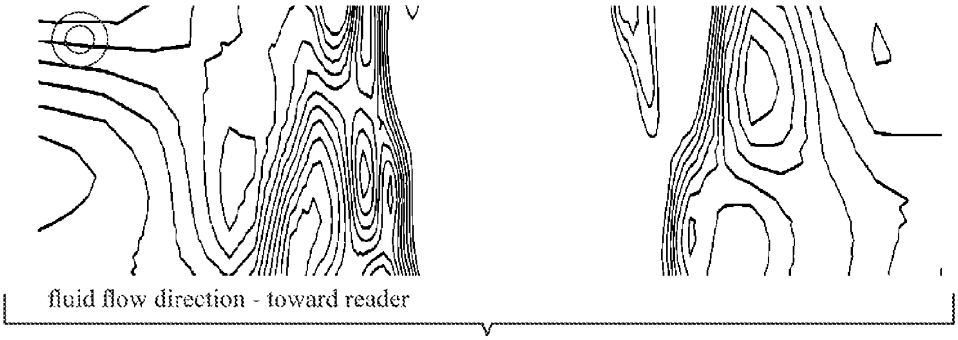

fluid flow direction - toward reader

FIG. 8A

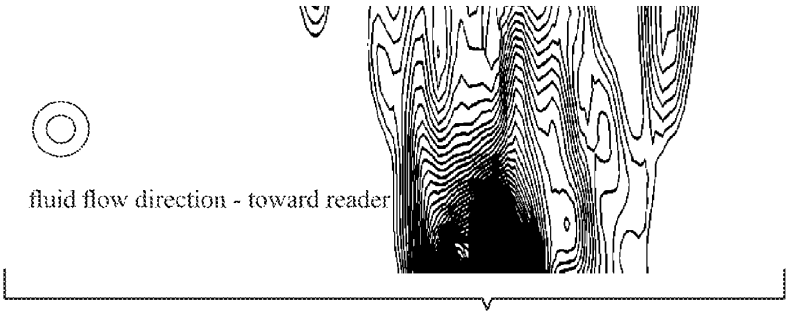

fluid flow direction - toward reader

FIG. 8B

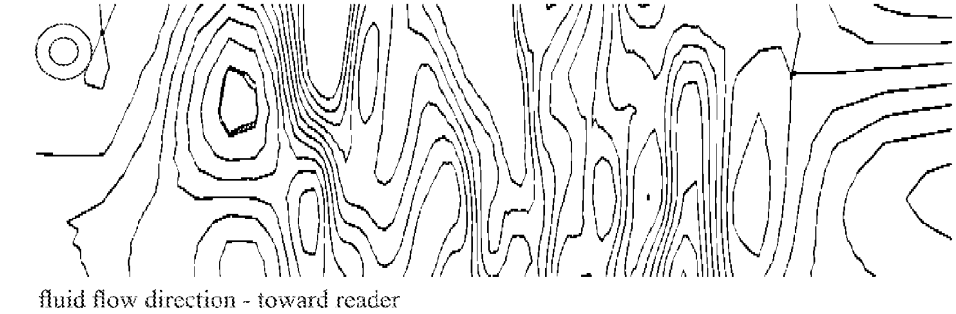

fluid flow direction - toward reader

FIG. 9A

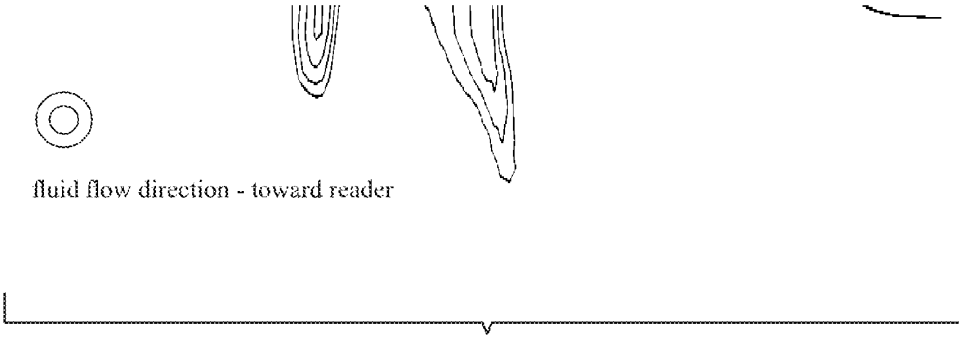

fluid flow direction - toward reader

FIG. 9B

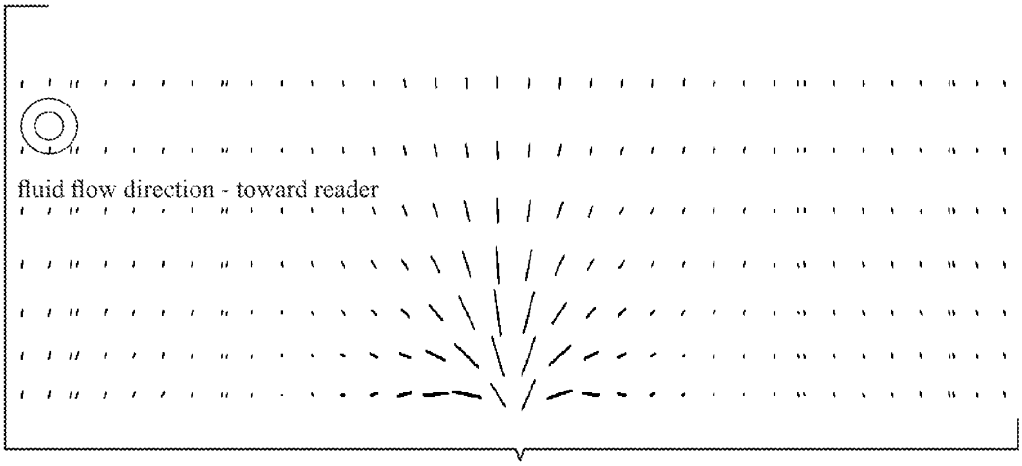


FIG. 10A

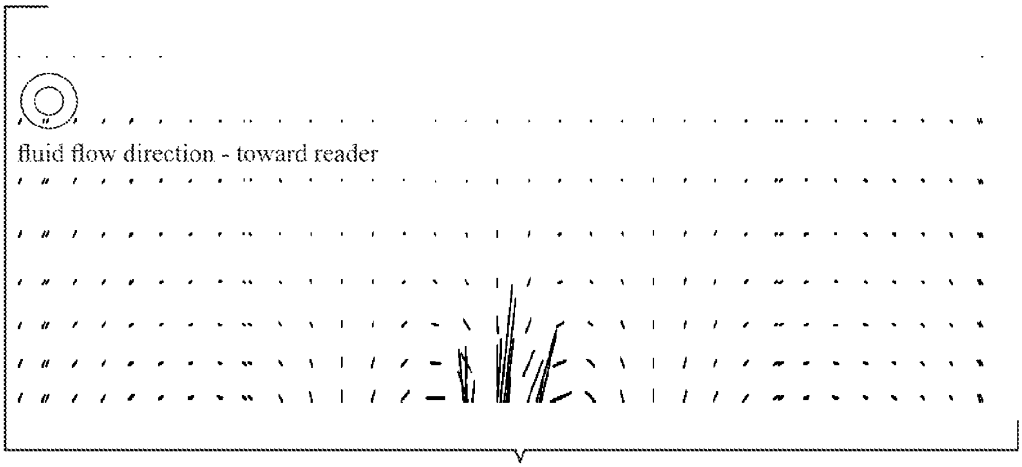


FIG. 10B

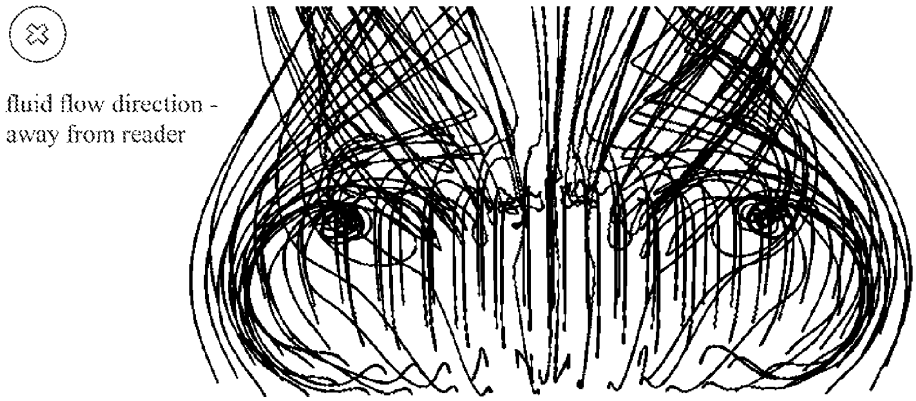


FIG. 11A

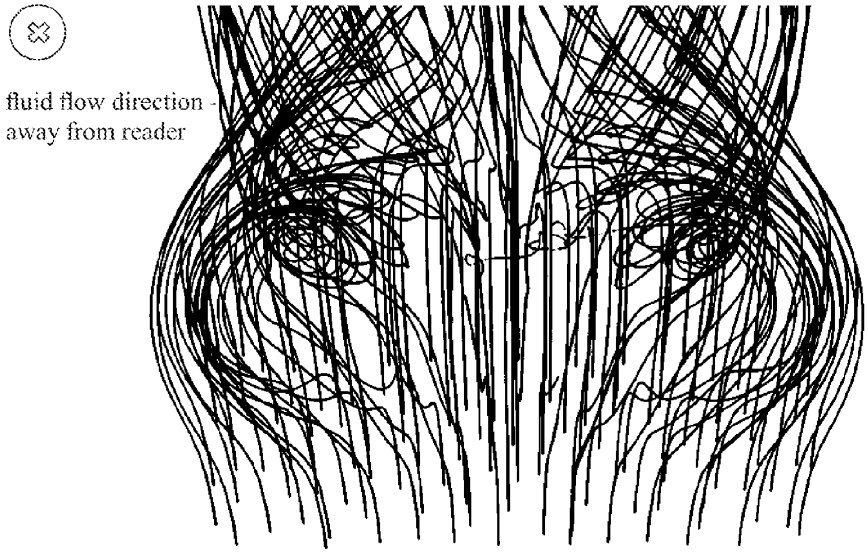


FIG. 11B

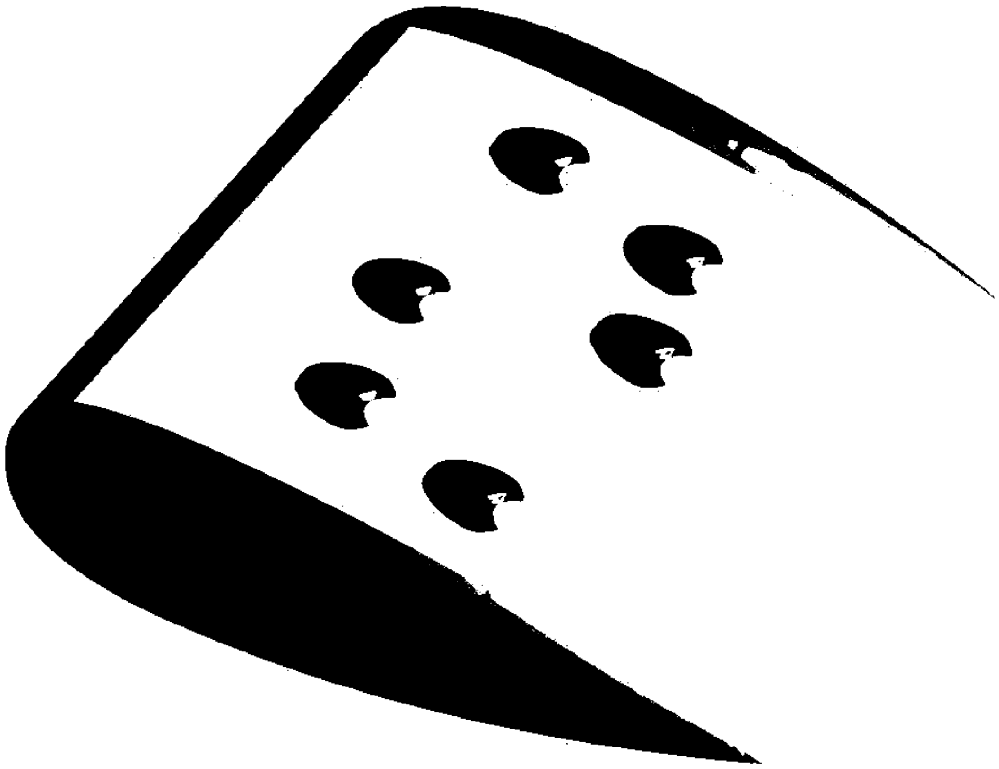


FIG. 12

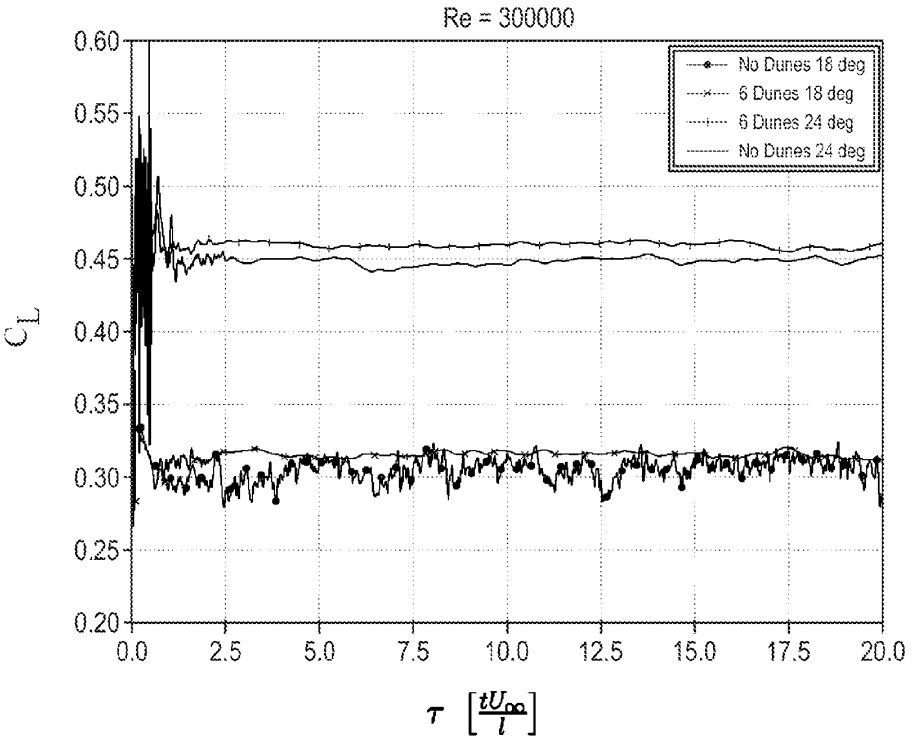

Re = 300000
No Dunes 18 deg
6 Dunes 18 deg
6 Dunes 24 deg
No Dunes 24 deg
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
C_L
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
$\tau \left[\frac{tU_\infty}{l}\right]$

FIG. 13

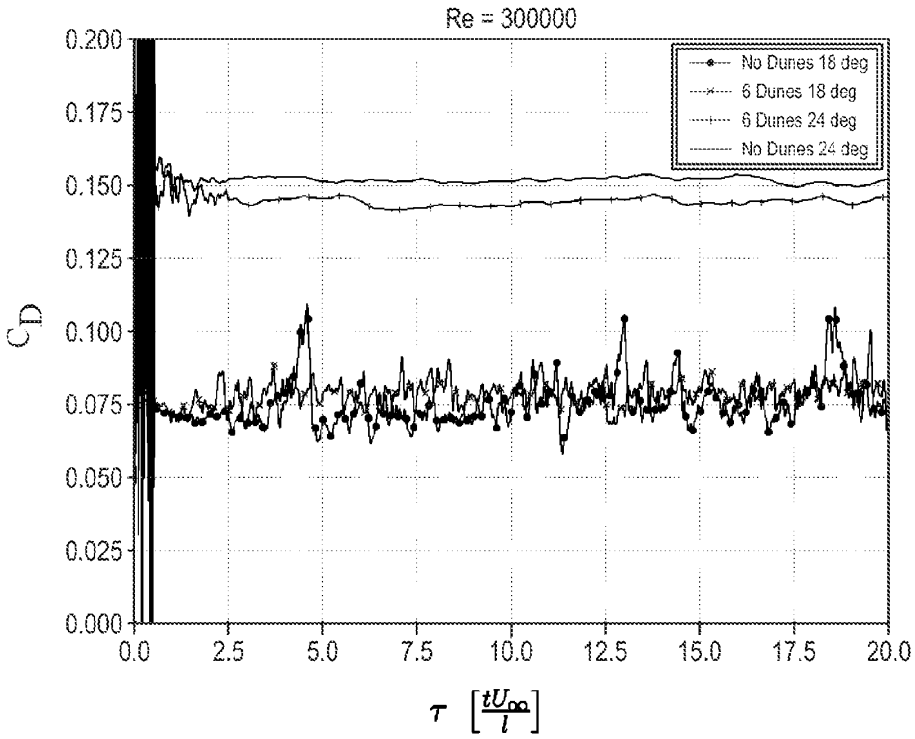

Re = 300000
No Dunes 18 deg
6 Dunes 18 deg
6 Dunes 24 deg
No Dunes 24 deg
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
C_D
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
$\tau \left[\frac{tU_\infty}{l}\right]$

FIG. 14

Angle of attack [degrees]	CL mean no dunes	CL mean with dunes	Difference %
18	0.3	0.315	4.87
24	0.4585	0.451	-1.64
26	0.4837	0.4896	-1.21

FIG. 15

Angle of attack [degrees]	CD mean no dunes	CD mean with dunes	Difference %
18	0.075	0.0777	3.53
24	0.1515	0.1468	-3.15
26	0.1716	0.1714	-

FIG. 16

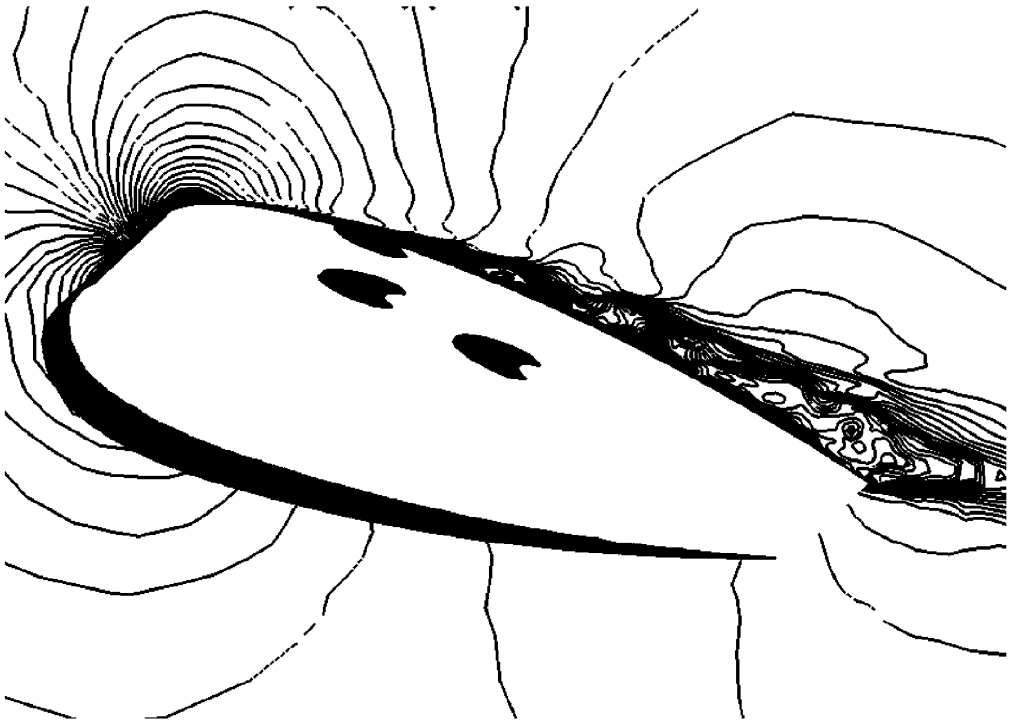


FIG. 17

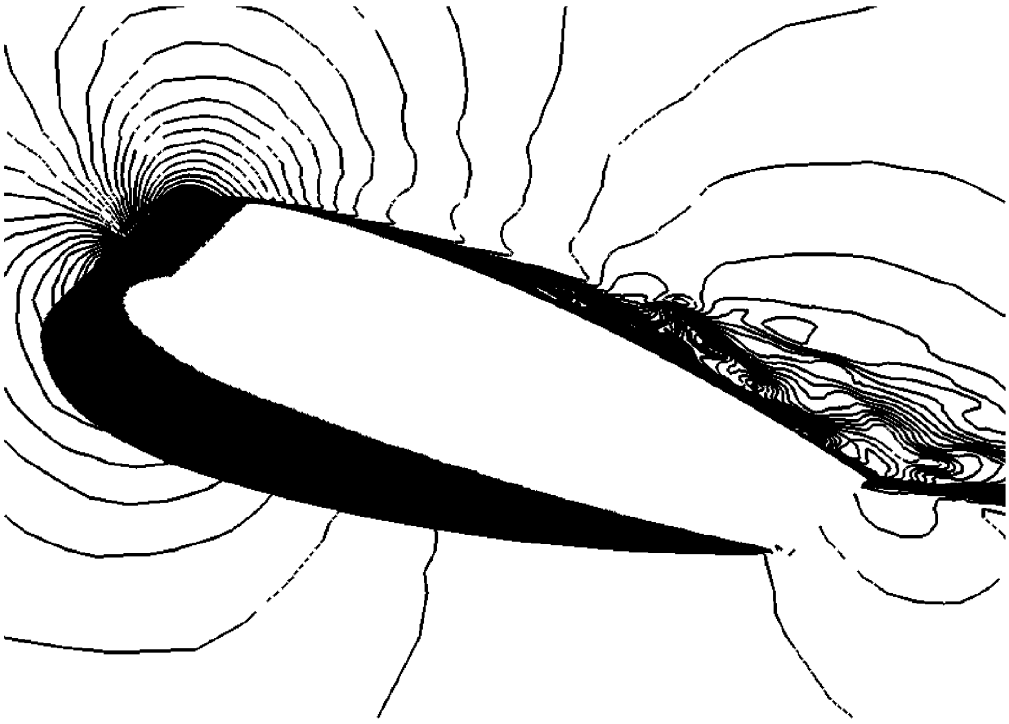


FIG. 18

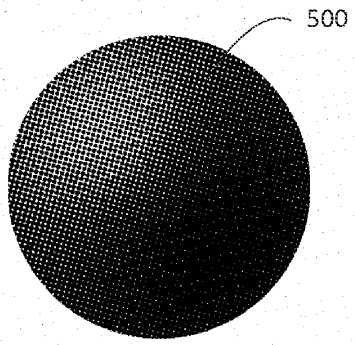


FIG. 19A

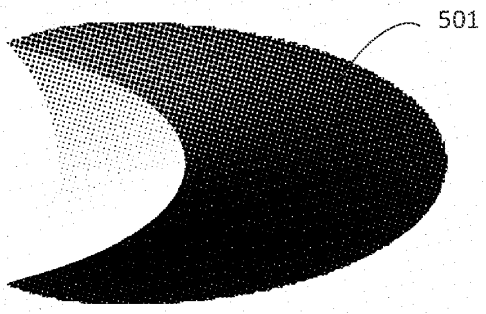


FIG. 19B

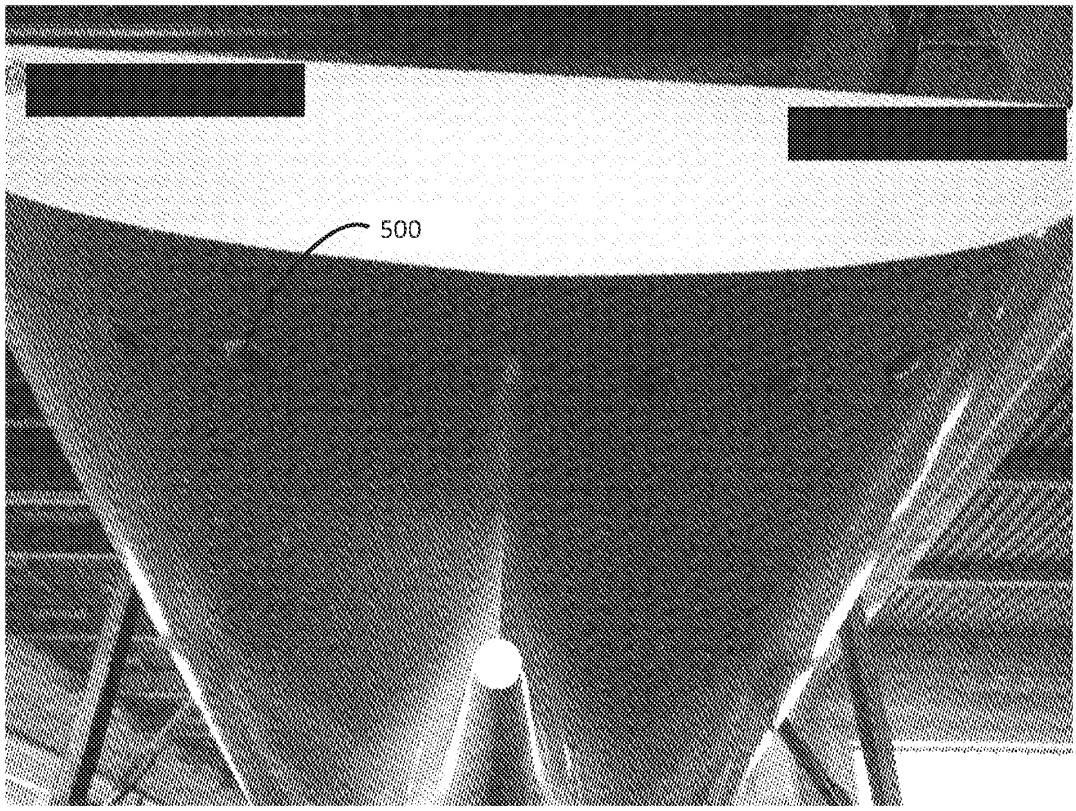


FIG. 20

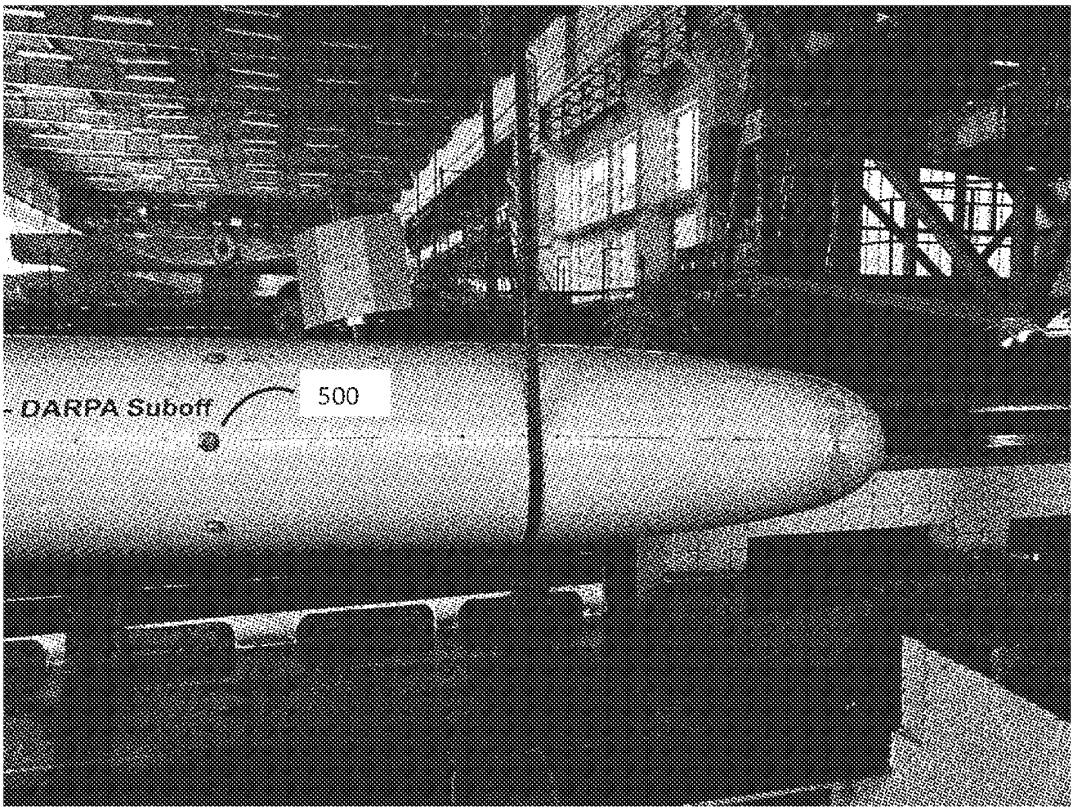


FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2024/021176

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***F15D 1/00*** (2024.01); ***F01D 5/14*** (2024.01); ***B62D 35/00*** (2024.01); *B63B 1/36* (2024.01); *B64C 1/38* (2024.01); *B64C 21/02* (2024.01); *B64C 21/10* (2024.01); *F15D 1/12* (2024.01)

CPC: ***F15D 1/003; F15D 1/004; F15D 1/0055; F15D 1/00; F01D 5/145; F01D 5/14; B62D 35/00;*** *B63B 1/36; B64C 1/38; B64C 21/02; B64C 21/10; F15D 1/12*

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)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2021/0388858 A1 (Peer Belt Inc) 16 December 2021 (16.12.2021) entire document, especially Figs 1-18	1-10, 24-32, 46-85
A	US 2011/0315248 A1 (Simpson et al) 29 December 2011 (29.12.2011) entire document, especially Figs 1-18	1-10, 24-32, 46-85
A	US 2018/0162521 A1 (Airbus Defence and Space GmbH) 14 June 2018 (14.06.2018) entire document	1-10, 24-32, 46-85
A	US 2015/0329200 A1 (University of Kansas) 17 November 2015 (17.11.2015) entire document	1-10, 24-32, 46-85
A	US 5,058,837 A (Wheeler) 22 October 1991 (22.10.1991) entire document	1-10, 24-32, 46-85

☐ 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
"D" document cited by the applicant in the international application
"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
07 October 2024 (07.10.2024)	**16 December 2024 (16.12.2024)**

Name and mailing address of the ISA/US	Authorized officer
COMMISSIONER FOR PATENTS **MAIL STOP PCT, ATTN: ISA/US** **P.O. Box 1450** **Alexandria, VA 22313-1450** **UNITED STATES OF AMERICA**	**KARI RODRIQUEZ**
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PCT/US2024/021176

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☑ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: **1-10, 24-32, 46-85**

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.