FIG. 1

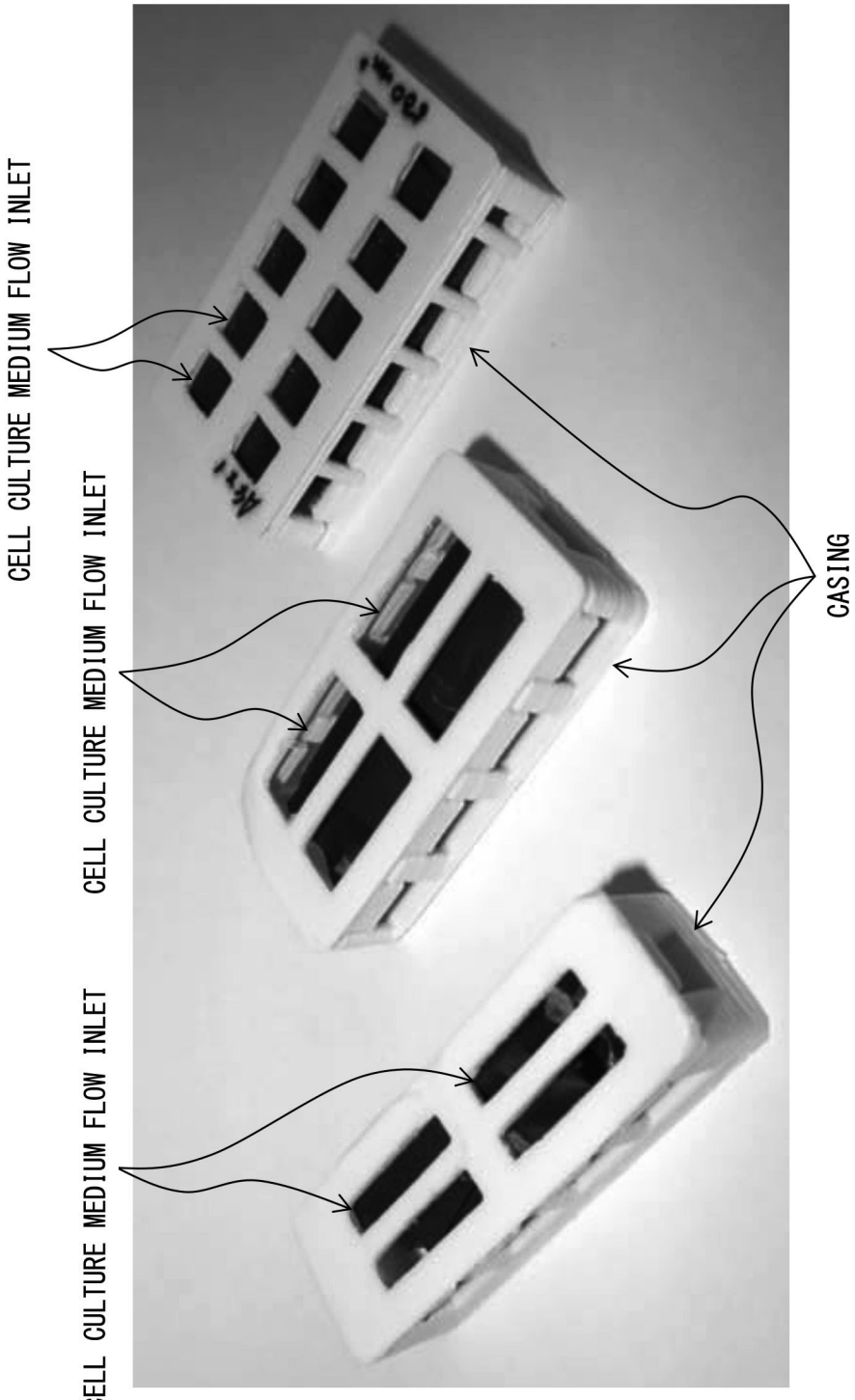

CELL CULTURE MEDIUM FLOW INLET
CELL CULTURE MEDIUM FLOW INLET
CELL CULTURE MEDIUM FLOW INLET
CASING

FIG. 2

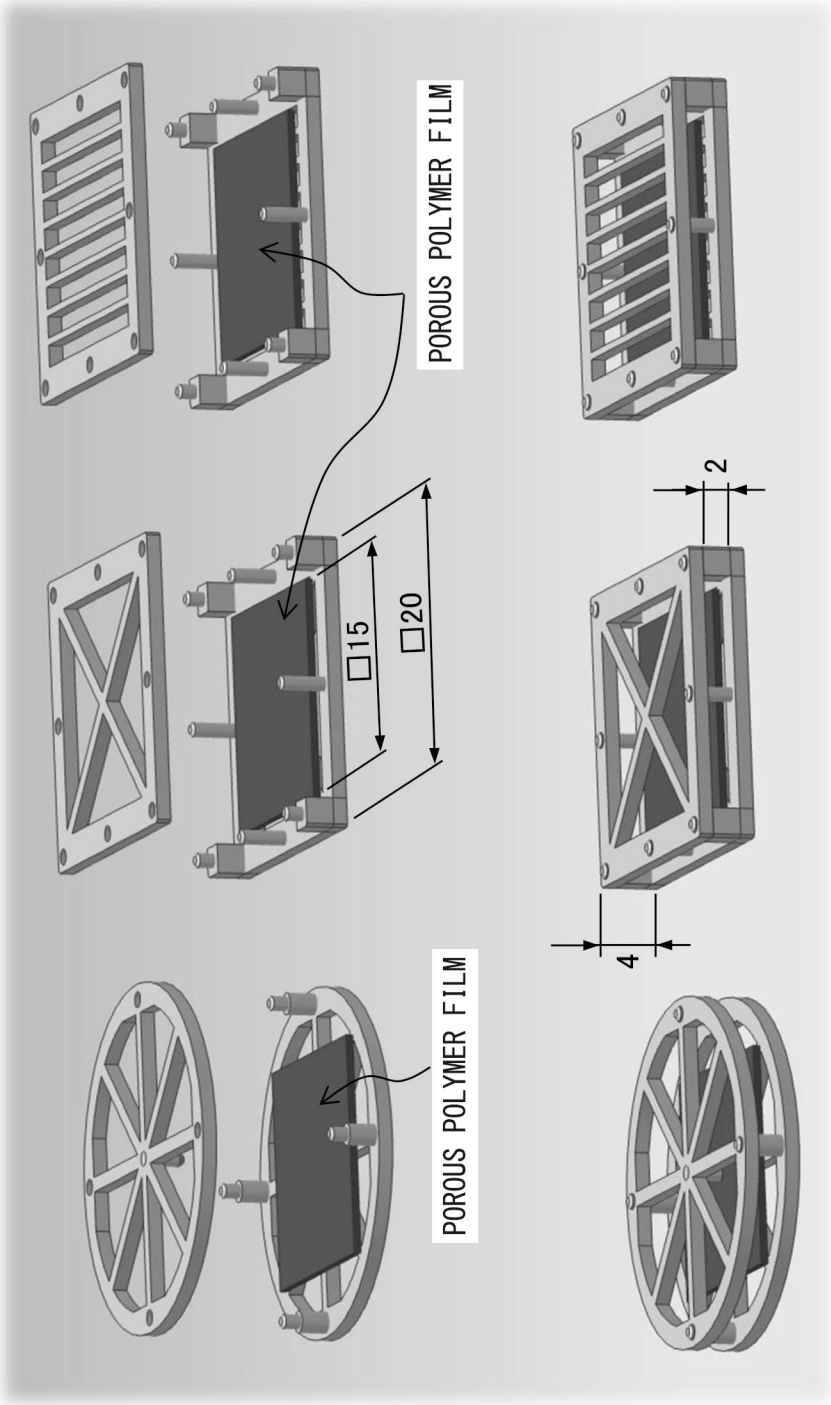


FIG. 3

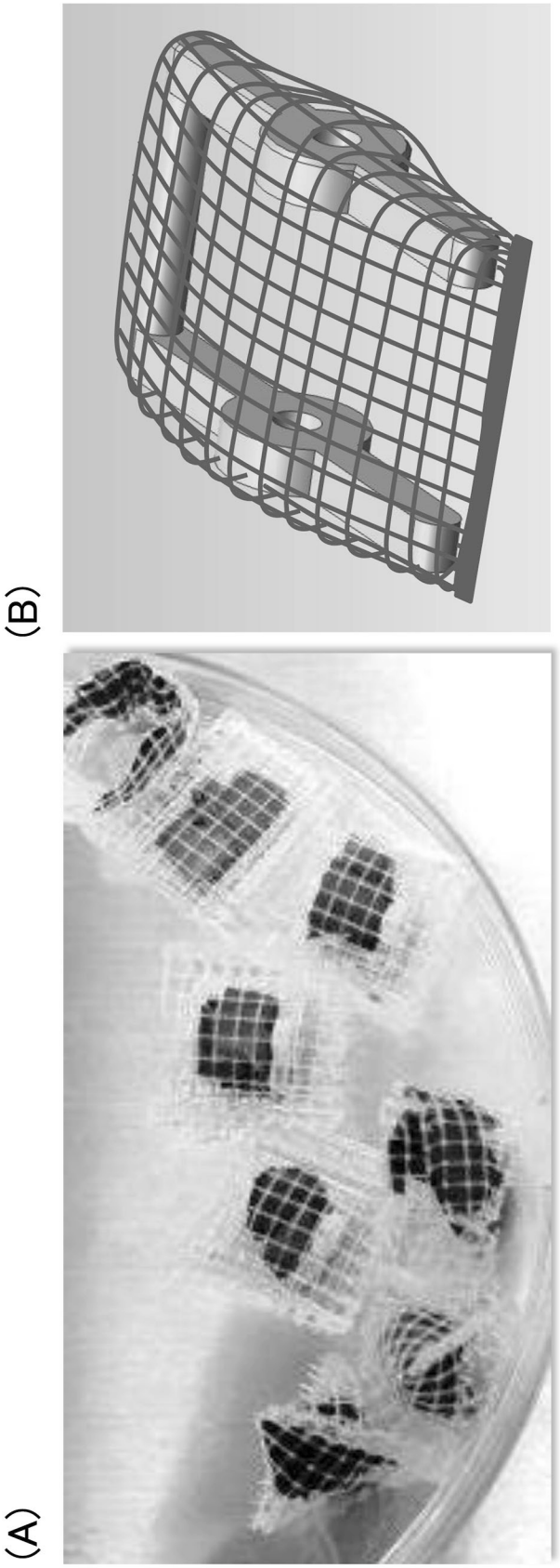
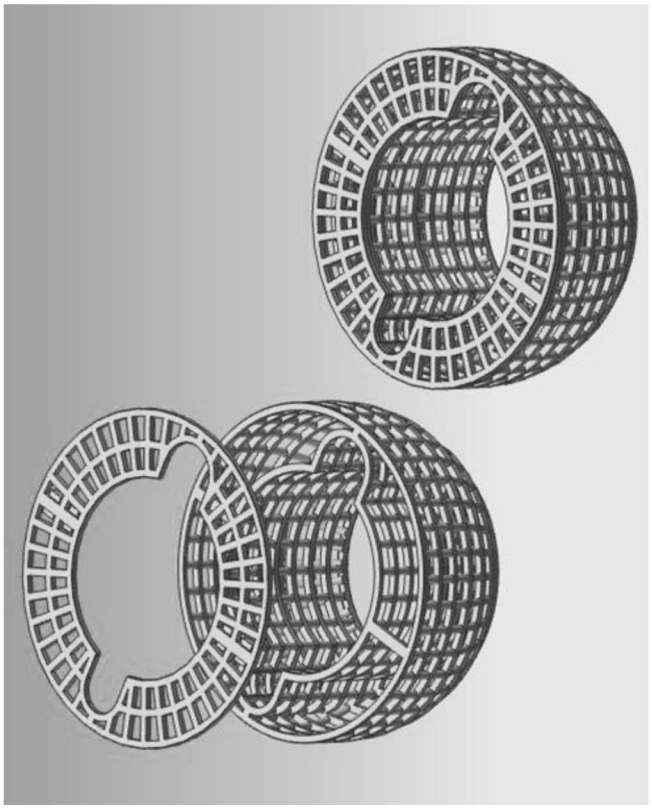


FIG. 4

(B)



(A)

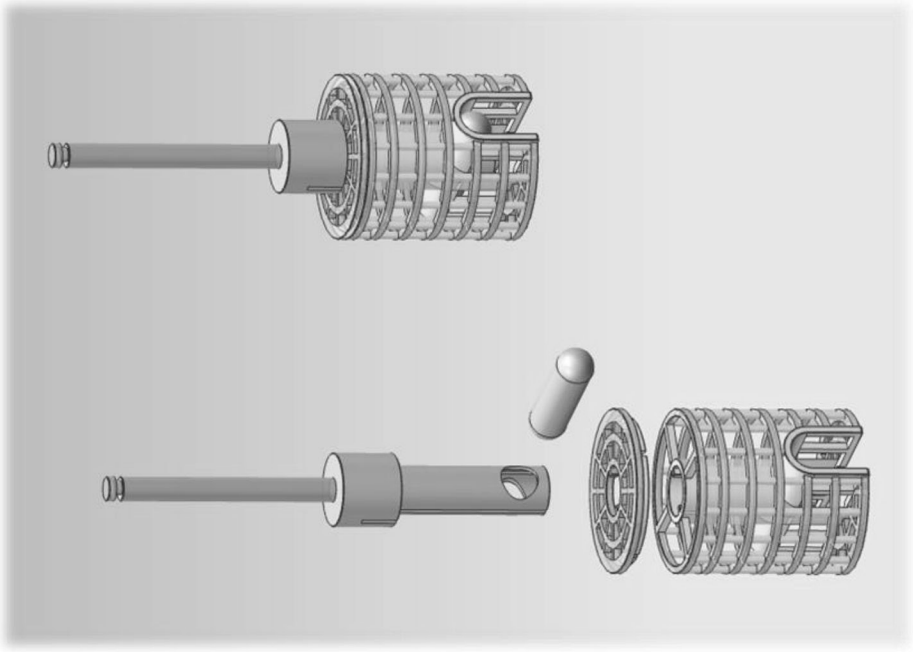


FIG. 5



ONE HOUR AFTER MEDIUM EXCHANGE



AT THE TIME OF MEDIUM EXCHANGE

FIG. 6



FIG. 7

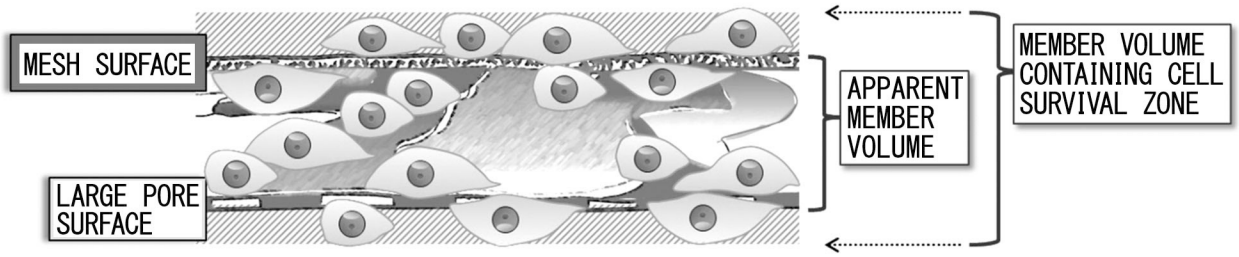

MESH SURFACE
LARGE PORE SURFACE
APPARENT MEMBER VOLUME
MEMBER VOLUME CONTAINING CELL SURVIVAL ZONE

FIG. 8

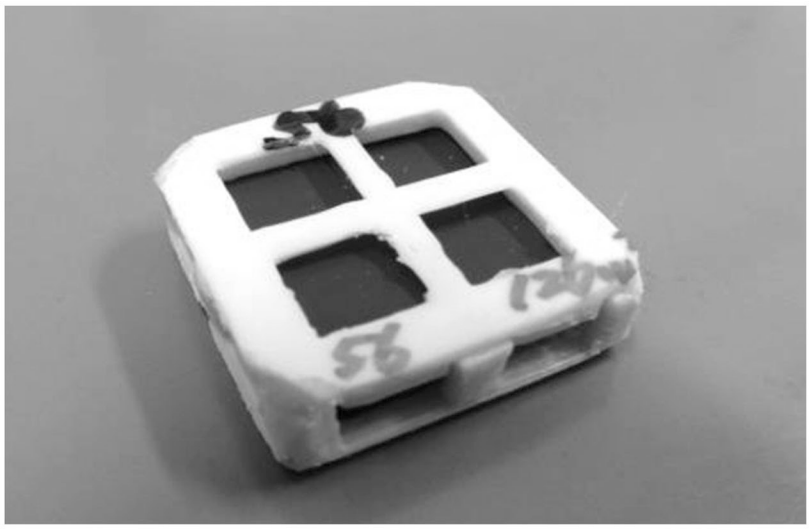


FIG. 9

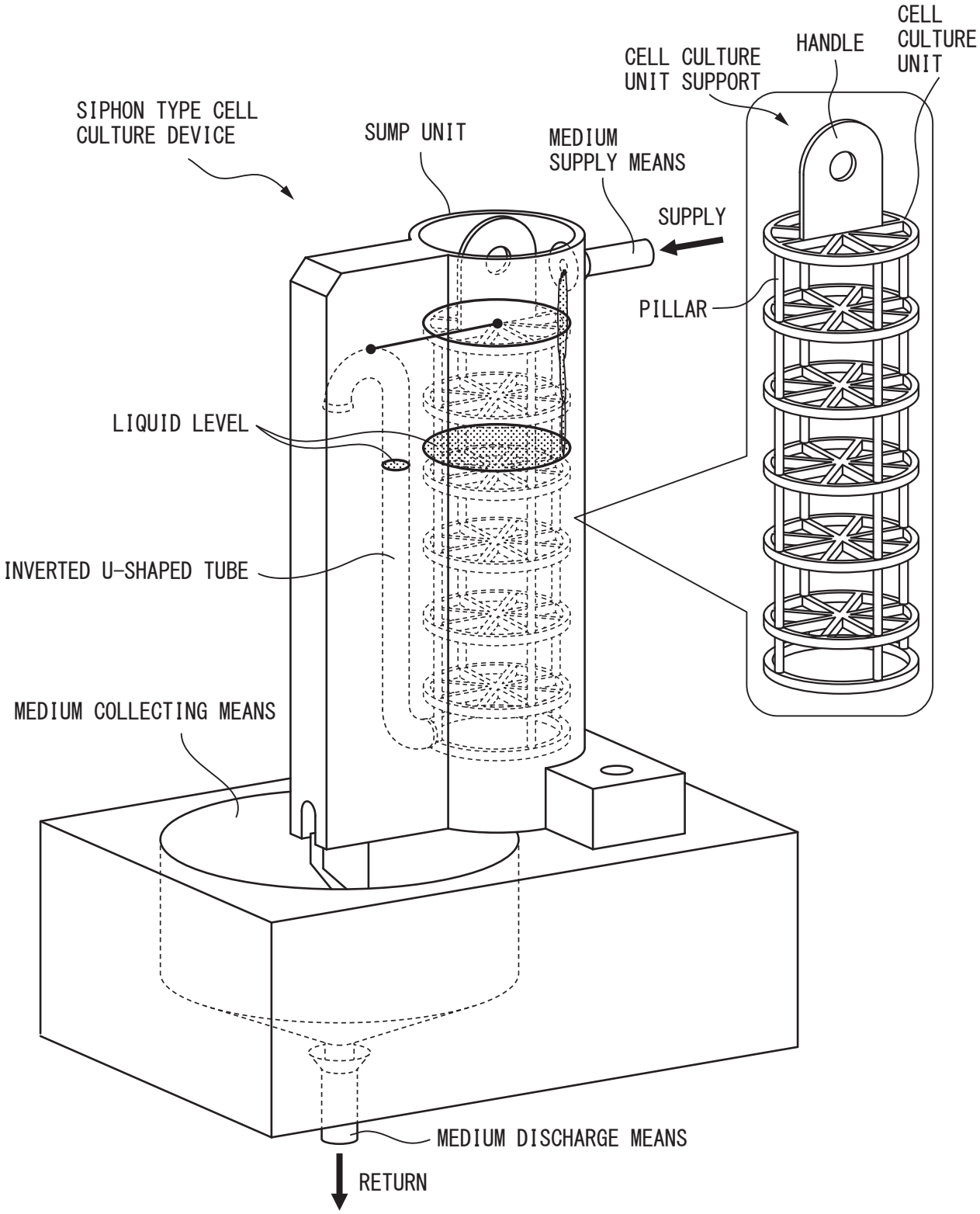

SIPHON TYPE CELL CULTURE DEVICE
SUMP UNIT
MEDIUM SUPPLY MEANS
SUPPLY
CELL CULTURE UNIT SUPPORT
HANDLE
CELL CULTURE UNIT
PILLAR
LIQUID LEVEL
INVERTED U-SHAPED TUBE
MEDIUM COLLECTING MEANS
MEDIUM DISCHARGE MEANS
RETURN

FIG. 10

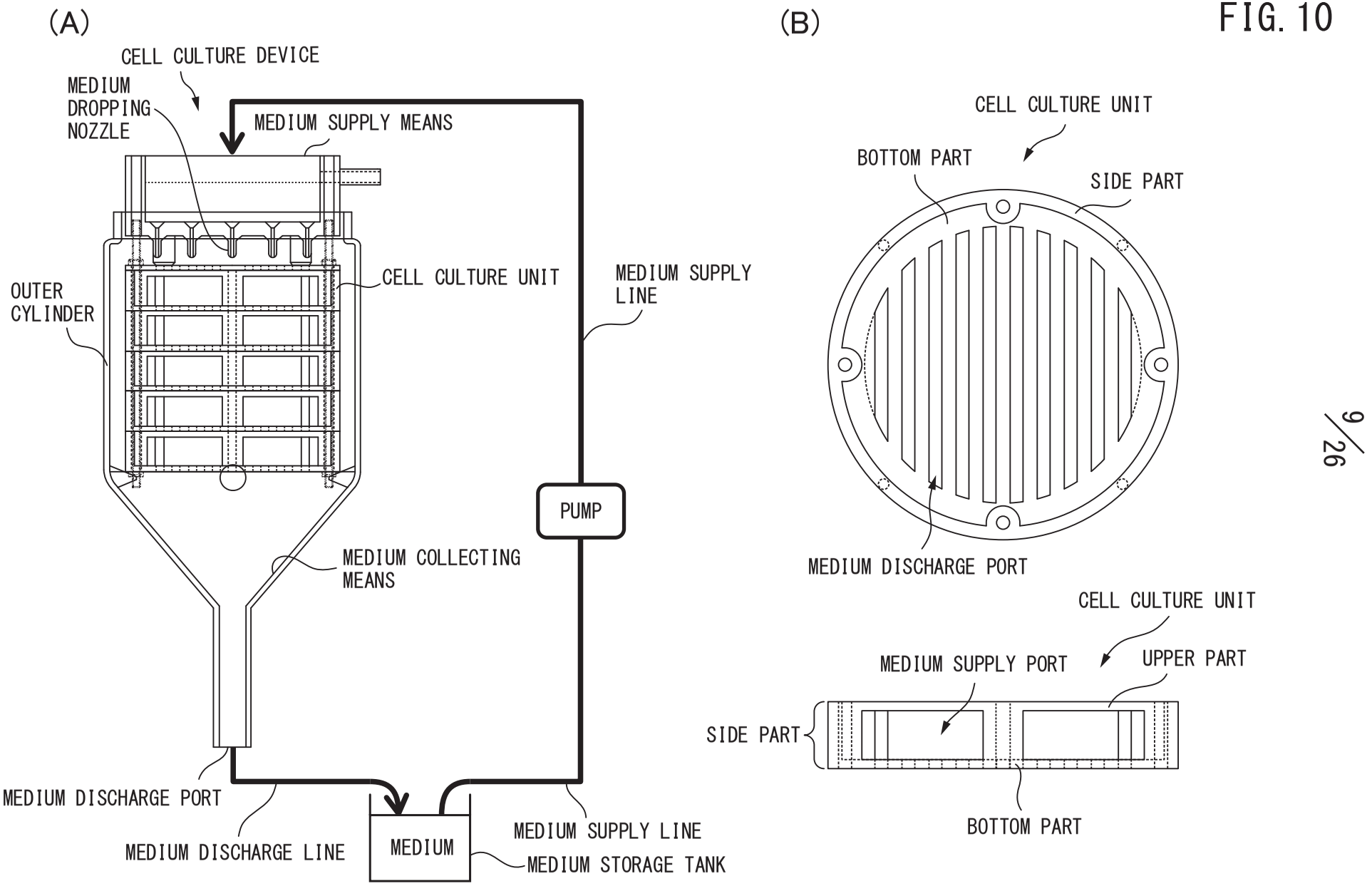

(A)
CELL CULTURE DEVICE
MEDIUM DROPPING NOZZLE
MEDIUM SUPPLY MEANS
CELL CULTURE UNIT
OUTER CYLINDER
MEDIUM SUPPLY LINE
PUMP
MEDIUM COLLECTING MEANS
MEDIUM DISCHARGE PORT
MEDIUM DISCHARGE LINE
MEDIUM
MEDIUM SUPPLY LINE
MEDIUM STORAGE TANK
(B)
CELL CULTURE UNIT
BOTTOM PART
SIDE PART
MEDIUM DISCHARGE PORT
CELL CULTURE UNIT
MEDIUM SUPPLY PORT
UPPER PART
SIDE PART
BOTTOM PART

FIG. 11

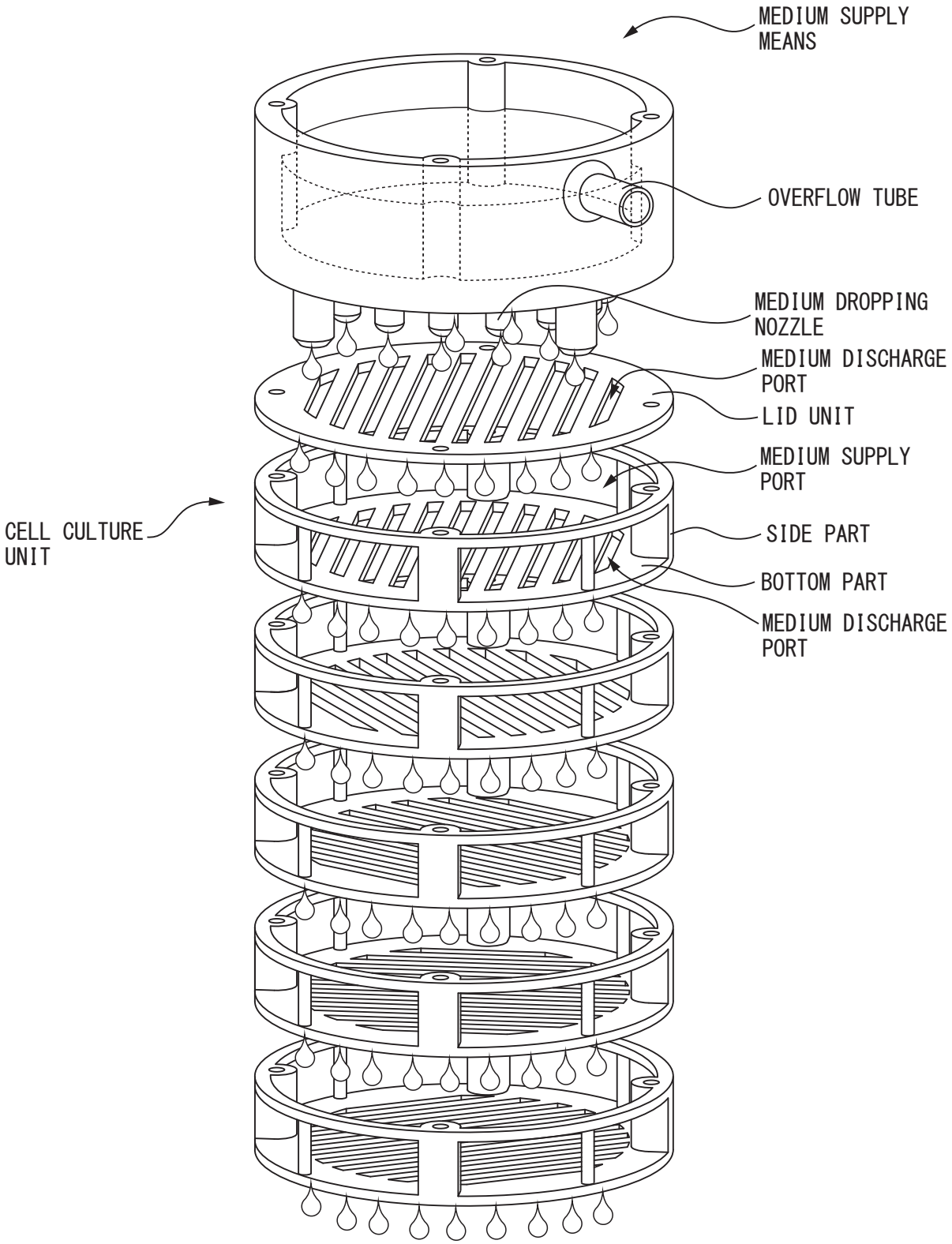

MEDIUM SUPPLY MEANS
OVERFLOW TUBE
MEDIUM DROPPING NOZZLE
MEDIUM DISCHARGE PORT
LID UNIT
MEDIUM SUPPLY PORT
SIDE PART
BOTTOM PART
MEDIUM DISCHARGE PORT
CELL CULTURE UNIT

FIG. 12

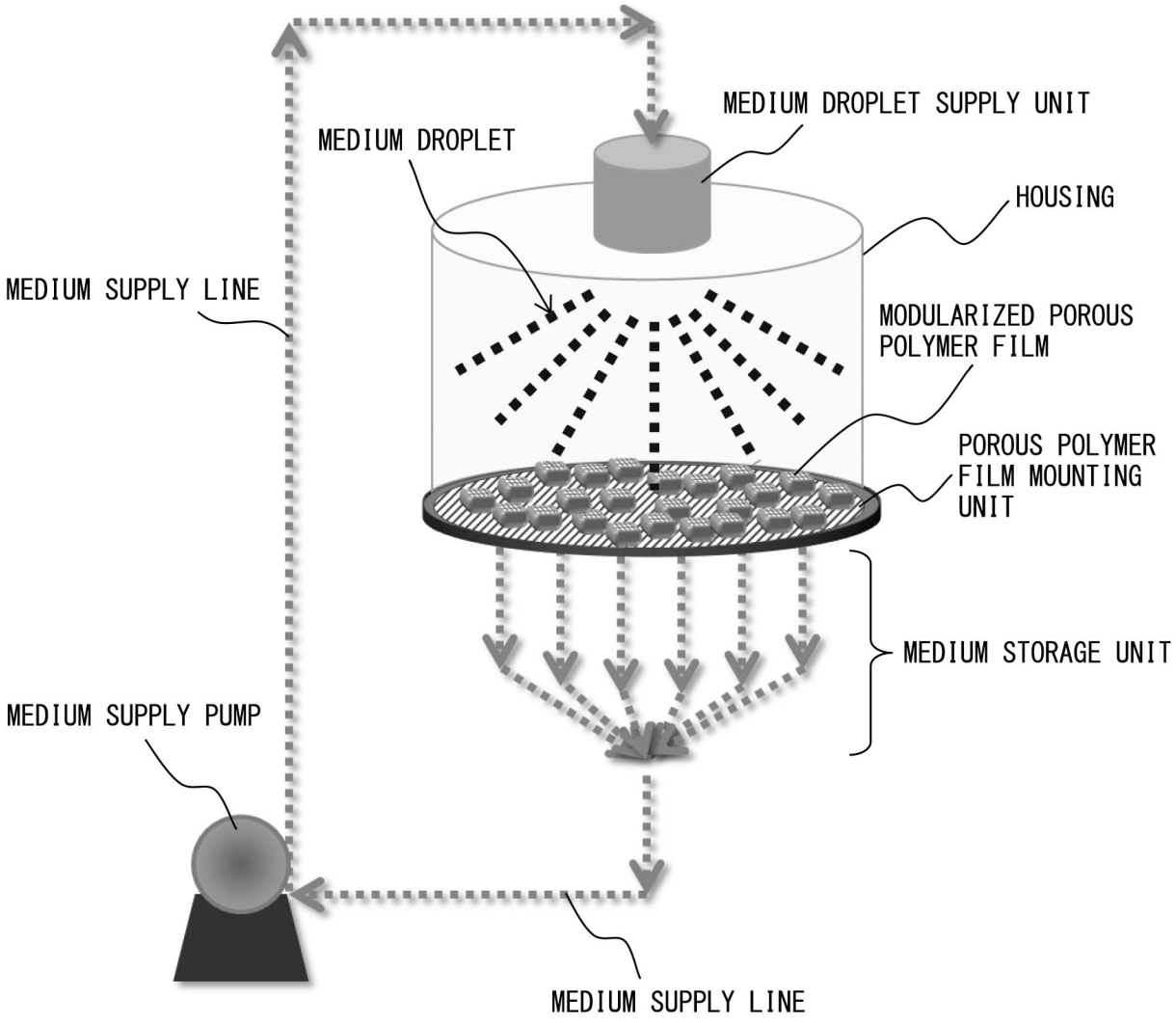

MEDIUM DROPLET SUPPLY UNIT
MEDIUM DROPLET
HOUSING
MEDIUM SUPPLY LINE
MODULARIZED POROUS POLYMER FILM
POROUS POLYMER FILM MOUNTING UNIT
MEDIUM STORAGE UNIT
MEDIUM SUPPLY PUMP
MEDIUM SUPPLY LINE

FIG. 13

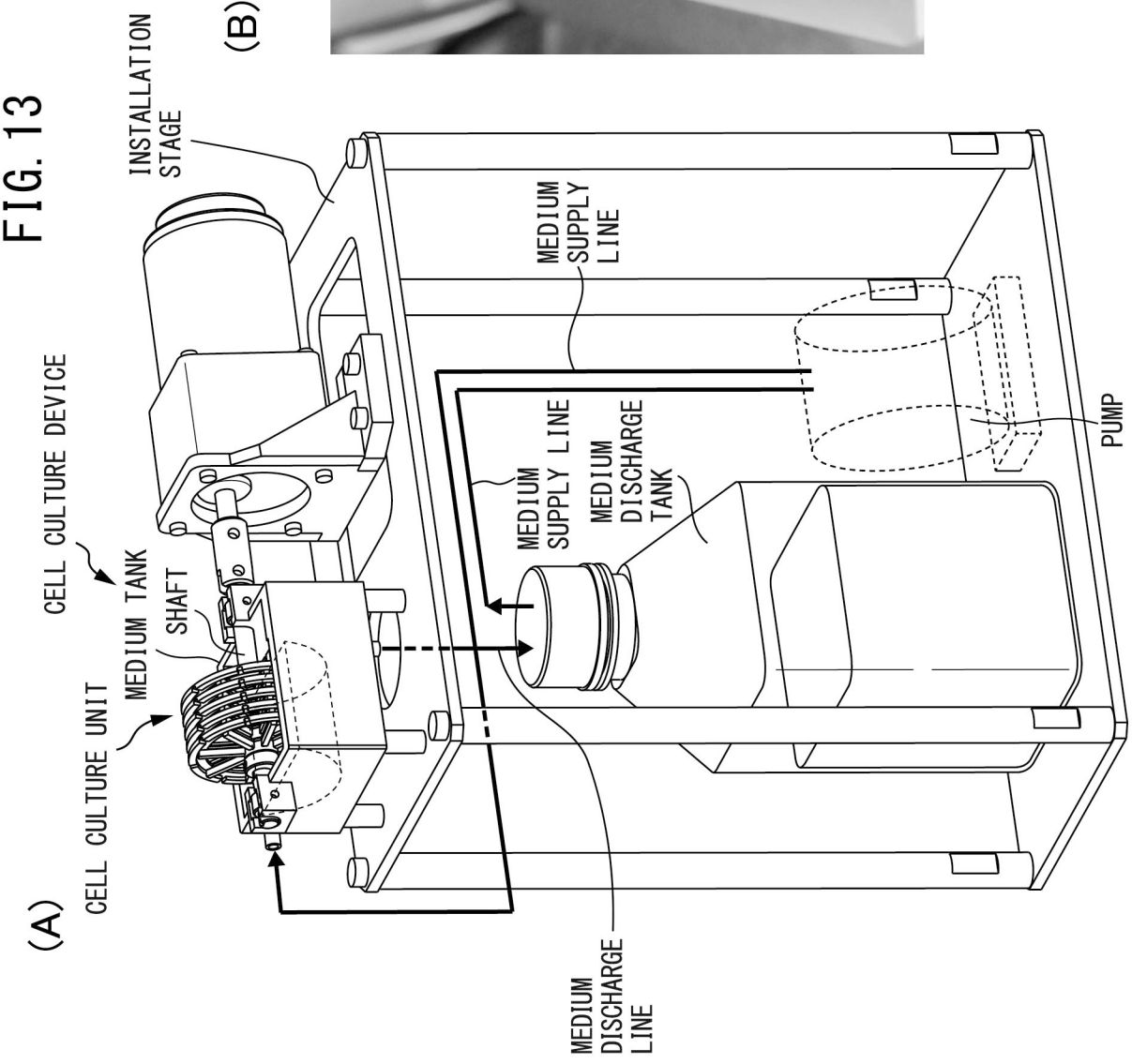
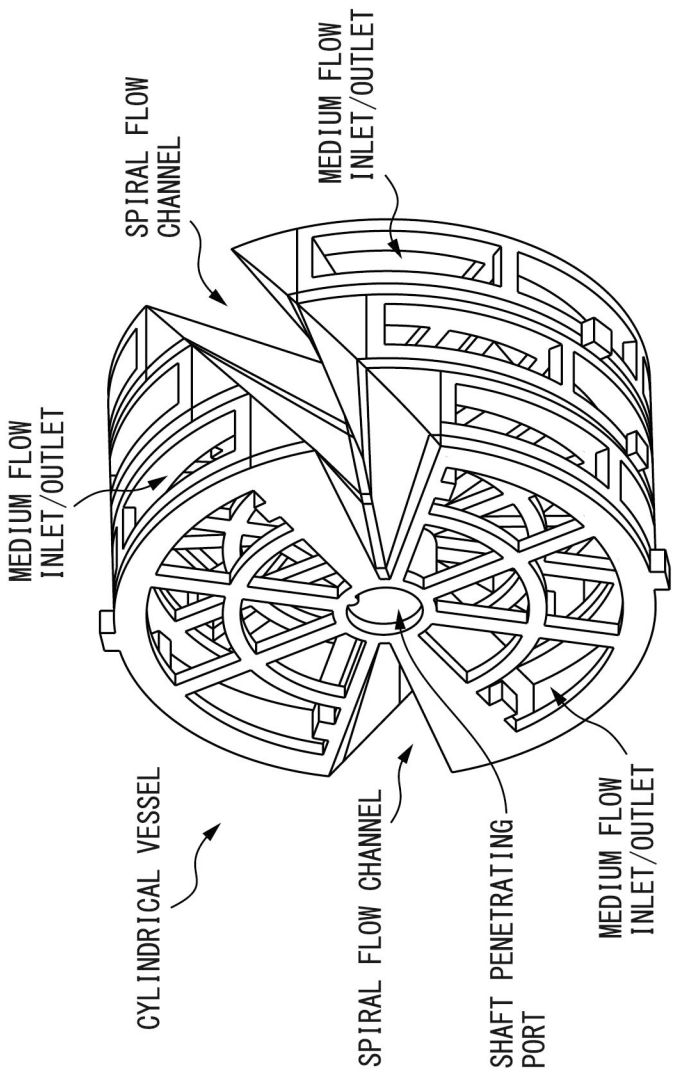

(A)
CELL CULTURE UNIT
CELL CULTURE DEVICE
MEDIUM TANK
SHAFT
INSTALLATION STAGE
MEDIUM SUPPLY LINE
MEDIUM SUPPLY LINE
MEDIUM DISCHARGE TANK
PUMP
MEDIUM DISCHARGE LINE
(B)

FIG. 14

(A)


MEDIUM FLOW INLET/OUTLET
SPIRAL FLOW CHANNEL
MEDIUM FLOW INLET/OUTLET
CYLINDRICAL VESSEL
SPIRAL FLOW CHANNEL
SHAFT PENETRATING PORT
MEDIUM FLOW INLET/OUTLET

(B)

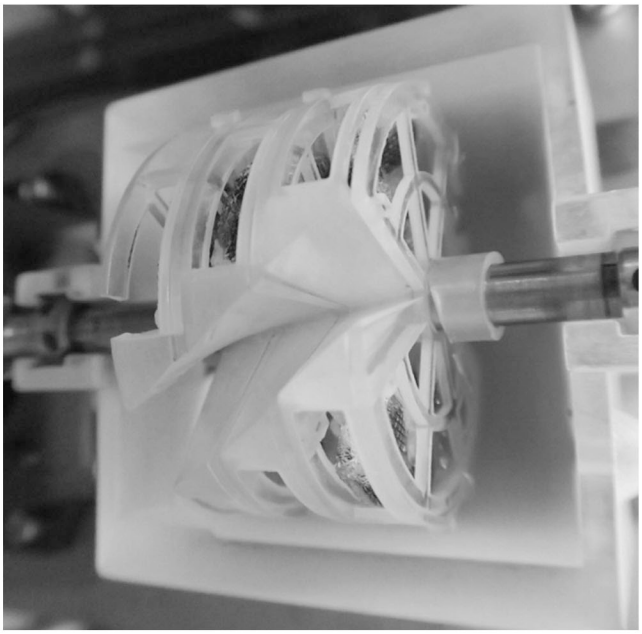


FIG. 15

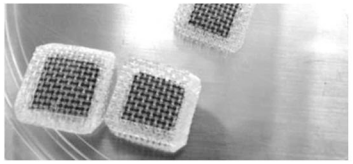
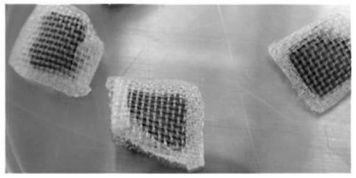
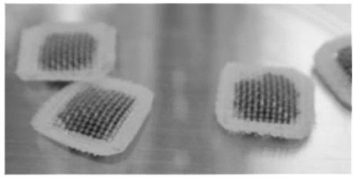
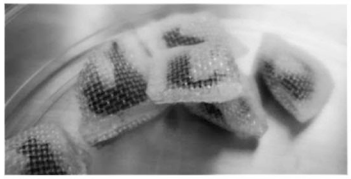
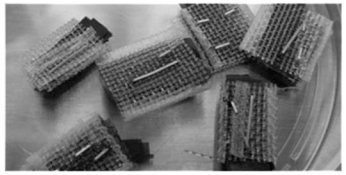
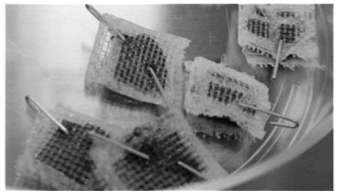
EXPERIMENT NAME	SHAPE OF POROUS POLYIMIDE FILM	PHOTOGRAPH OF MODULE	SHAPE OF MODULE
1	7mm×7mm 8OPIECES		PLANAR TYPE
2	7mm×7mm 8OPIECES		PARTIALLY PENETRATING TYPE
3	3.5mm×3.5mm 16OPIECES		PLANAR TYPE
4	3.5mm×3.5mm 16OPIECES		PARTIALLY PENETRATING TYPE
5	14mm×5mm 6OPIECES		2-POINT FIXED/EXPOSED TYPE
6	7mm×7mm 8OPIECES		1-POINT FIXED/EXPOSED TYPE

FIG. 16

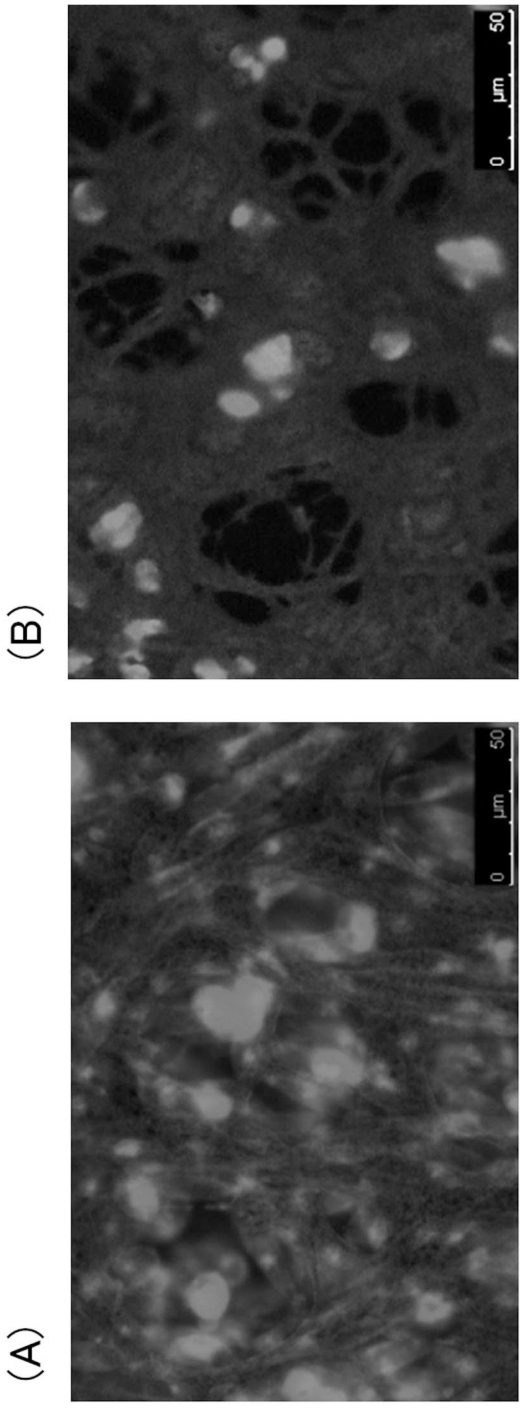


FIG. 17



FIG. 18

(A)



(B)



FIG. 19

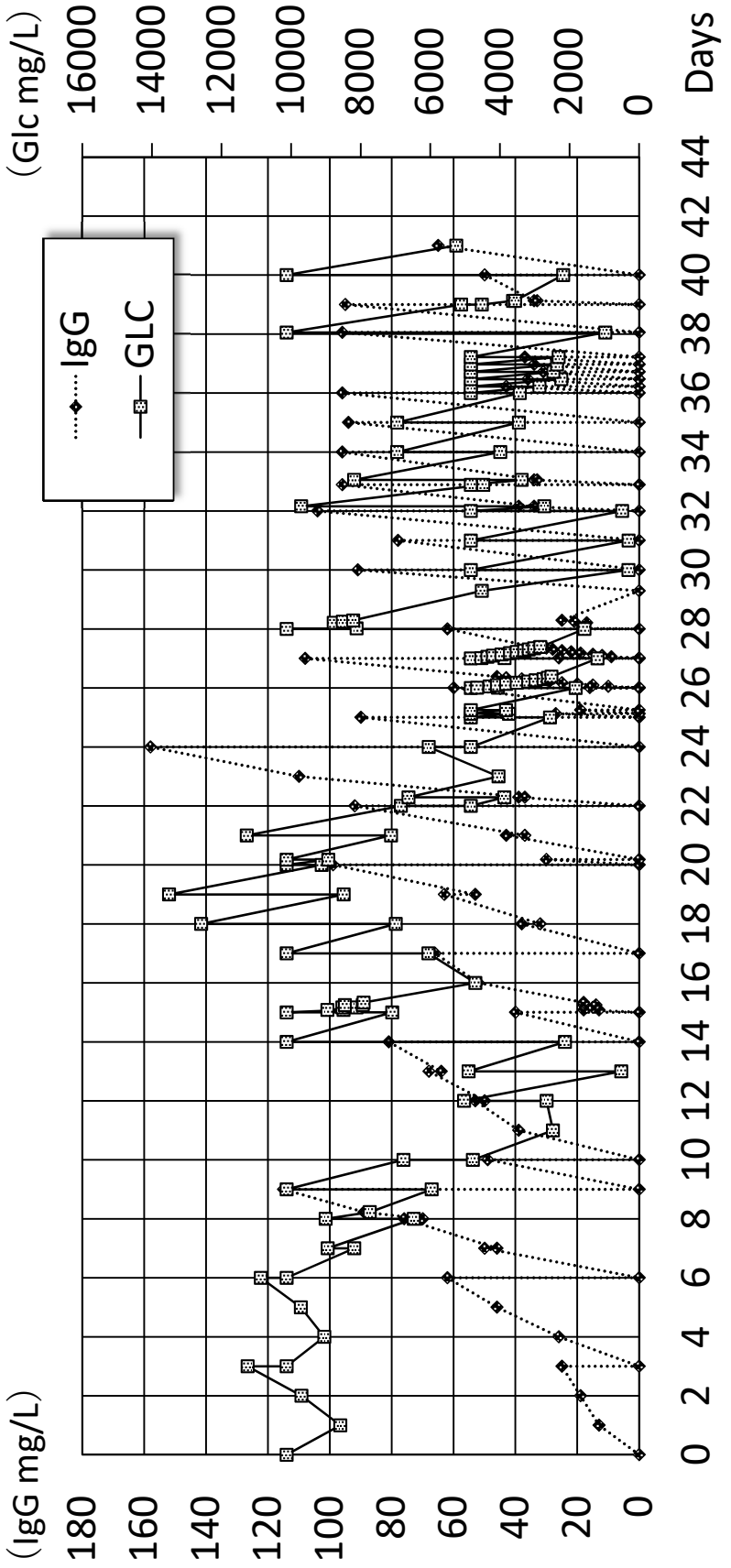
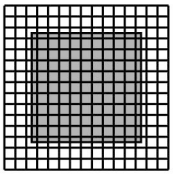
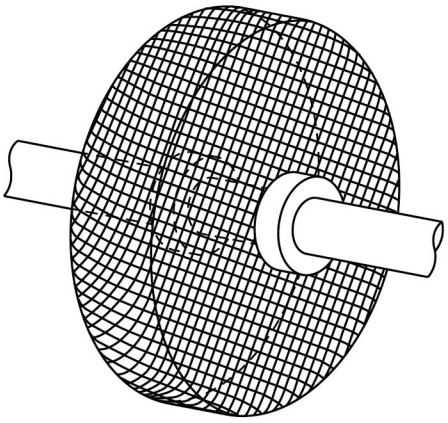

(IgG mg/L)
(Glc mg/L)
IgG
GLC
Days
0
20
40
60
80
100
120
140
160
180
0
2000
4000
6000
8000
10000
12000
14000
16000
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44

FIG. 20

(A)



(B)



(C)



FIG. 21

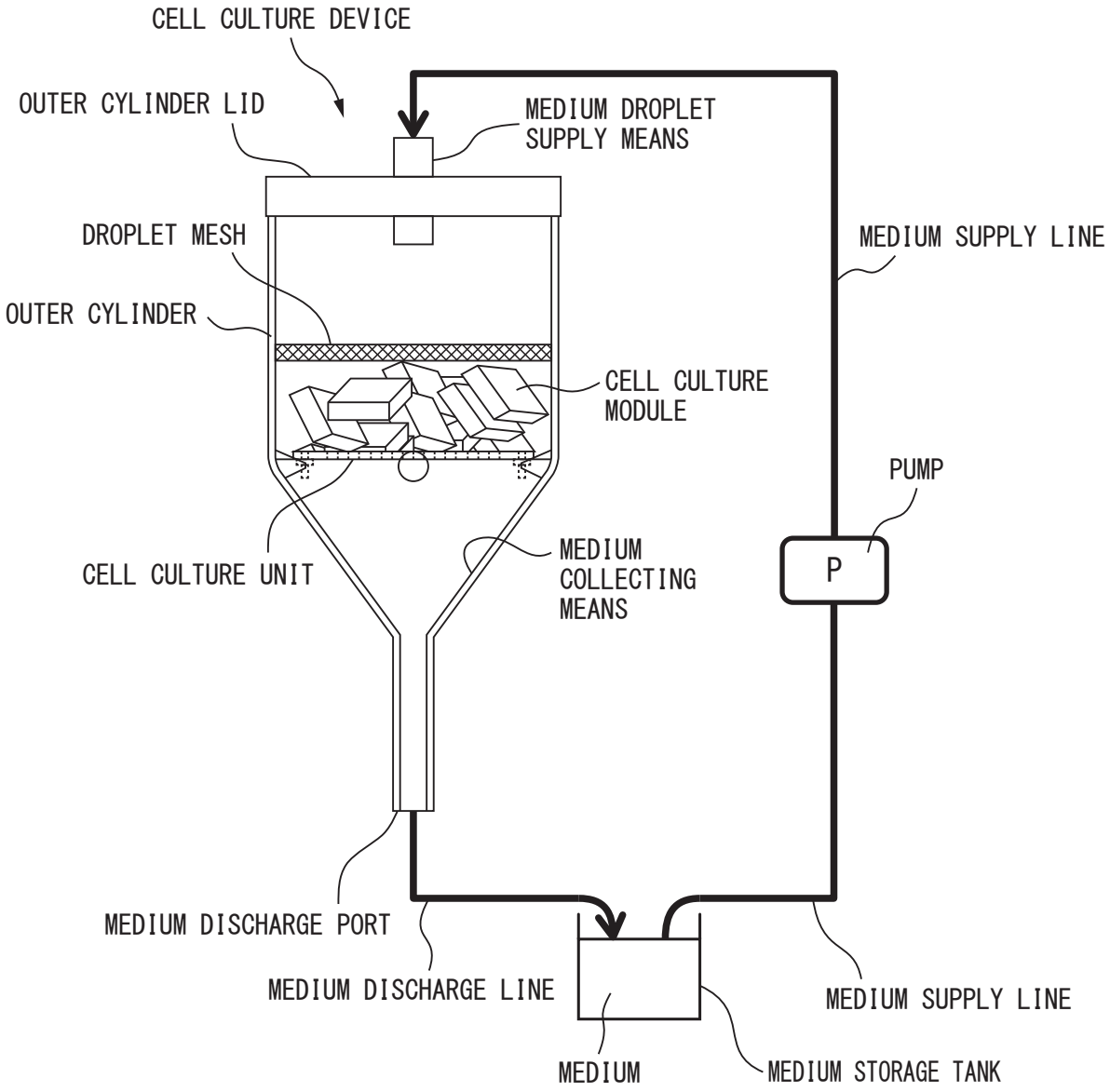

CELL CULTURE DEVICE
OUTER CYLINDER LID
MEDIUM DROPLET SUPPLY MEANS
DROPLET MESH
MEDIUM SUPPLY LINE
OUTER CYLINDER
CELL CULTURE MODULE
PUMP
P
CELL CULTURE UNIT
MEDIUM COLLECTING MEANS
MEDIUM DISCHARGE PORT
MEDIUM DISCHARGE LINE
MEDIUM SUPPLY LINE
MEDIUM
MEDIUM STORAGE TANK

FIG. 22

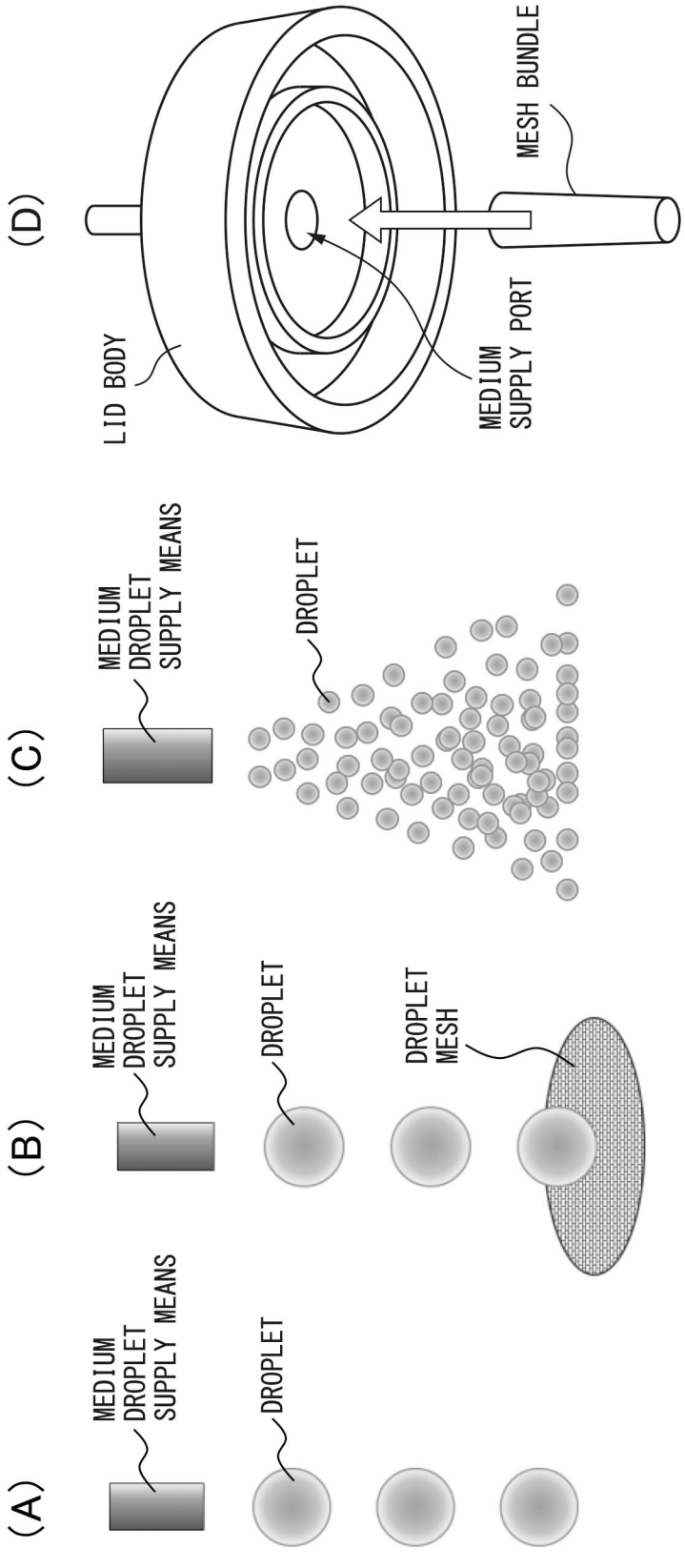

(A)
MEDIUM DROPLET SUPPLY MEANS
DROPLET
(B)
MEDIUM DROPLET SUPPLY MEANS
DROPLET
DROPLET MESH
(C)
MEDIUM DROPLET SUPPLY MEANS
DROPLET
(D)
LID BODY
MEDIUM SUPPLY PORT
MESH BUNDLE

FIG. 23

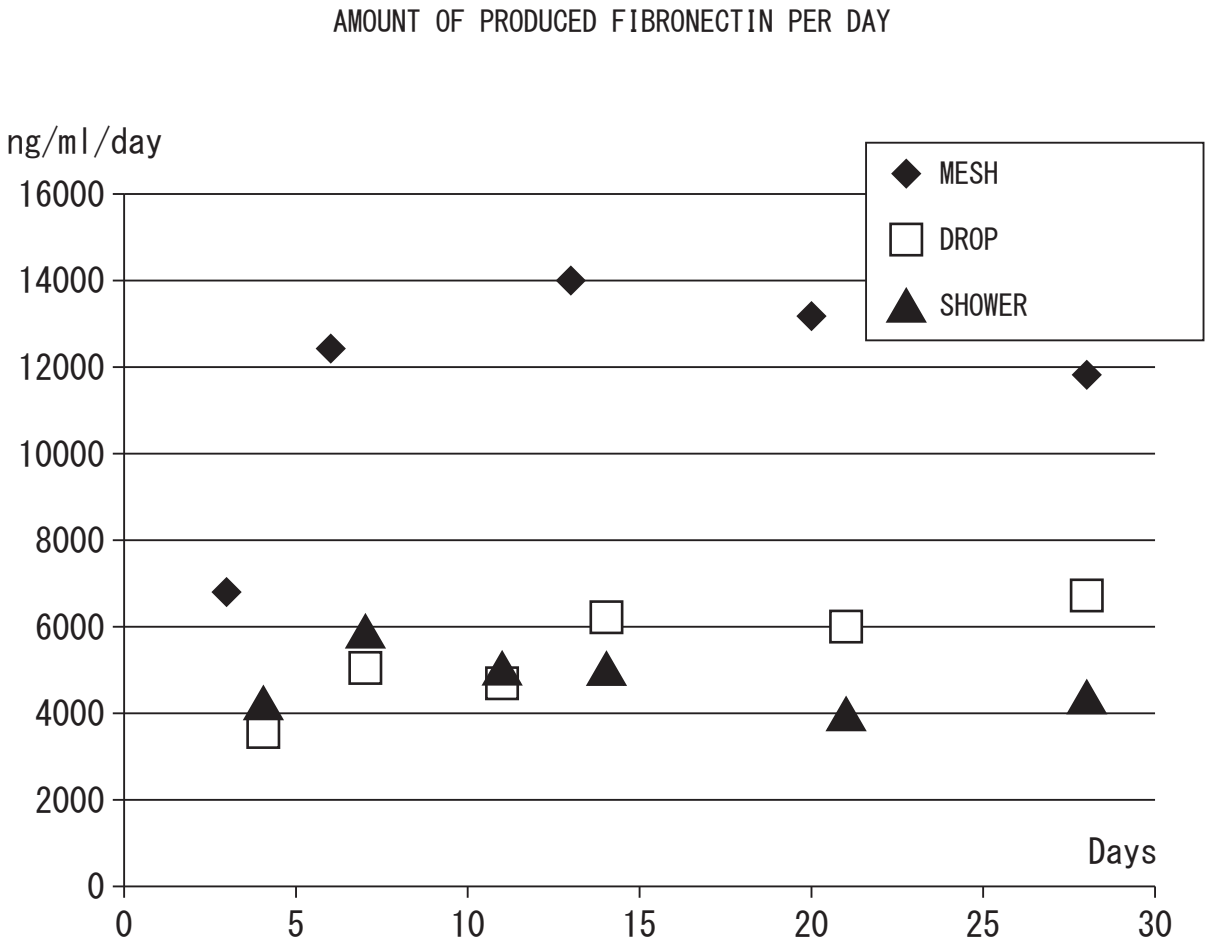

AMOUNT OF PRODUCED FIBRONECTIN PER DAY
ng/ml/day
16000
14000
12000
10000
8000
6000
4000
2000
0
0
5
10
15
20
25
30
Days
MESH
DROP
SHOWER

FIG. 24

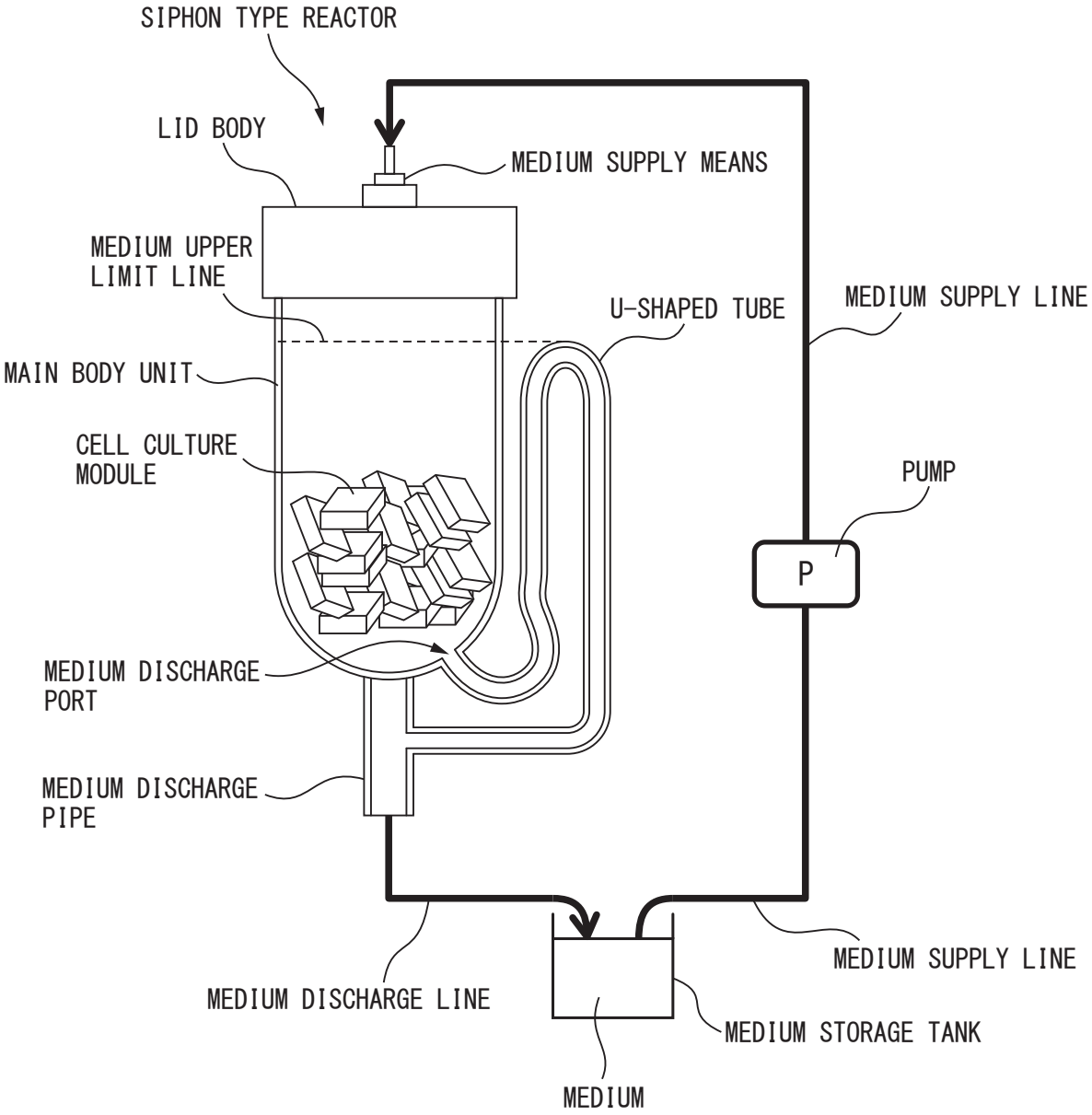

SIPHON TYPE REACTOR
LID BODY
MEDIUM SUPPLY MEANS
MEDIUM UPPER LIMIT LINE
U-SHAPED TUBE
MEDIUM SUPPLY LINE
MAIN BODY UNIT
CELL CULTURE MODULE
PUMP
P
MEDIUM DISCHARGE PORT
MEDIUM DISCHARGE PIPE
MEDIUM SUPPLY LINE
MEDIUM DISCHARGE LINE
MEDIUM STORAGE TANK
MEDIUM

FIG. 25

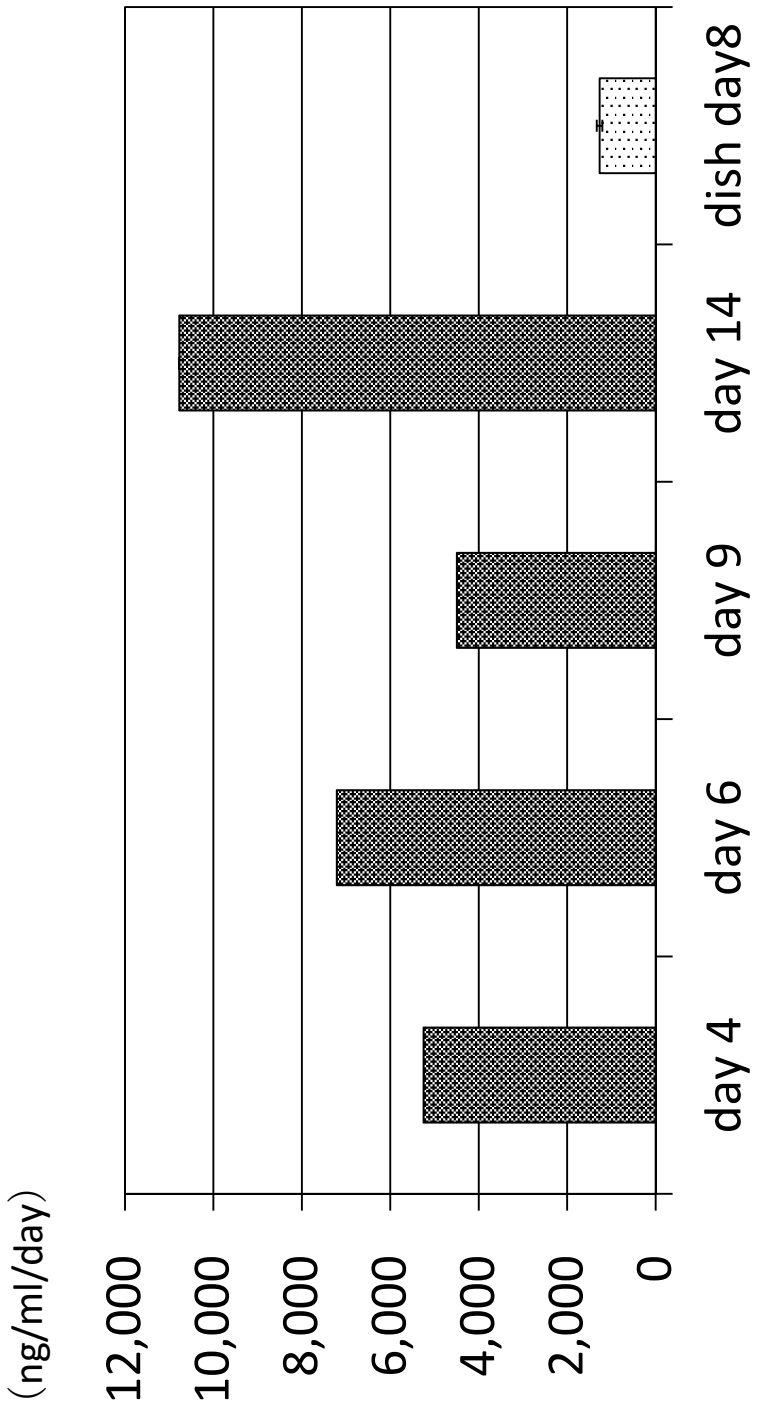

(ng/ml/day)
12,000
10,000
8,000
6,000
4,000
2,000
0
day 4
day 6
day 9
day 14
dish day8

FIG. 26

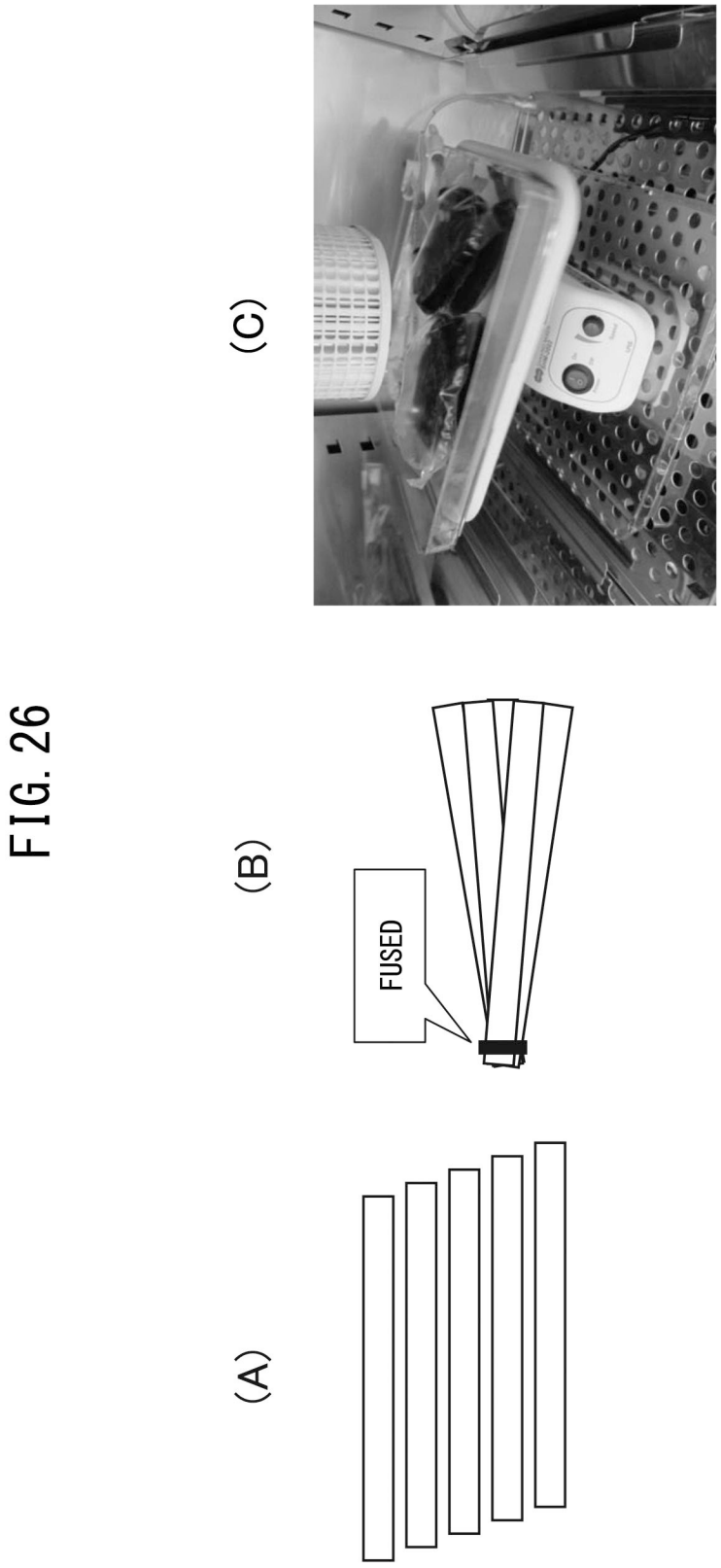
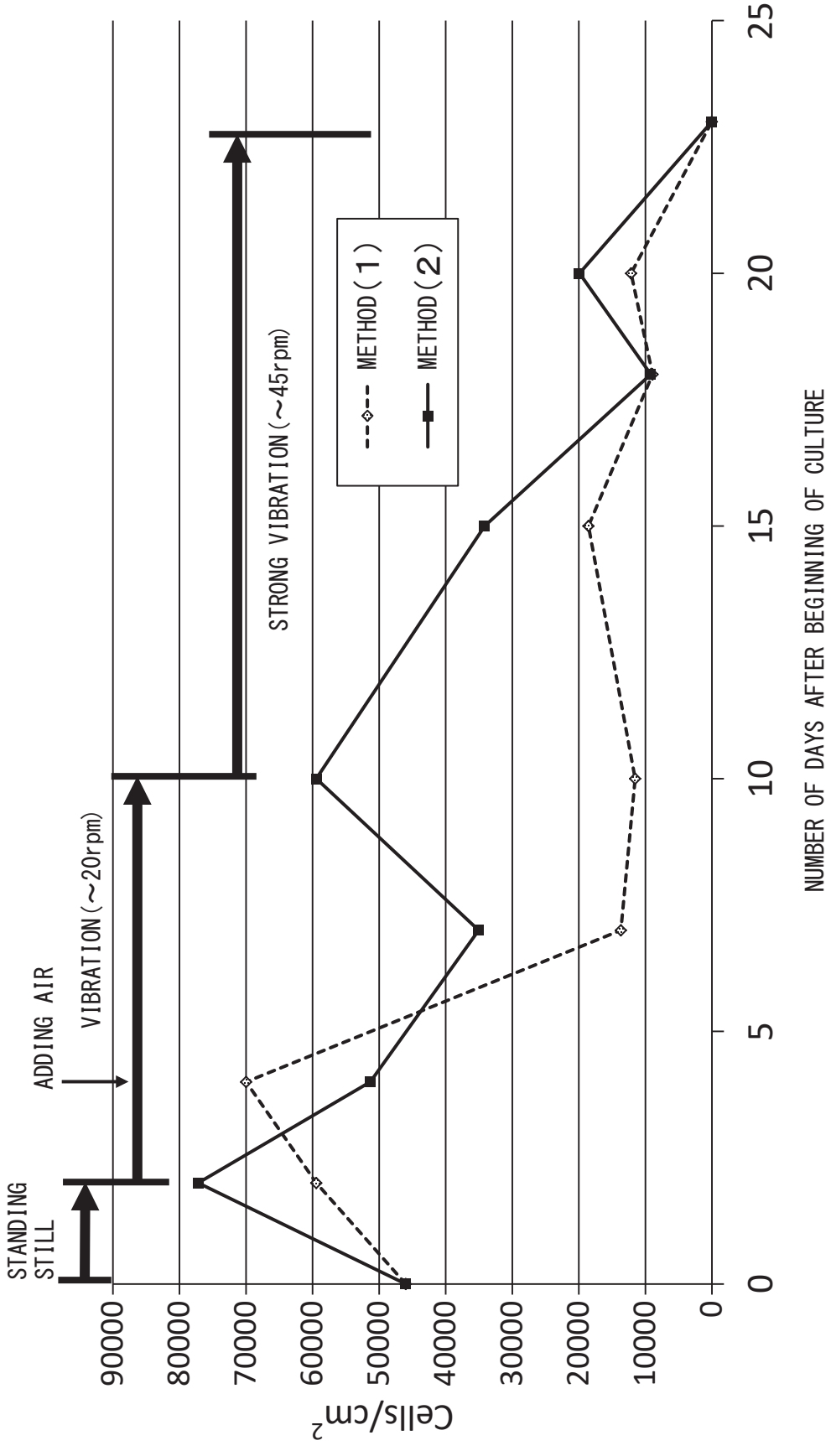


FIG. 27


STANDING STILL
ADDING AIR
VIBRATION(~20rpm)
STRONG VIBRATION(~45rpm)
METHOD(1)
METHOD(2)
Cells/cm²
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
5
10
15
20
25
NUMBER OF DAYS AFTER BEGINNING OF CULTURE