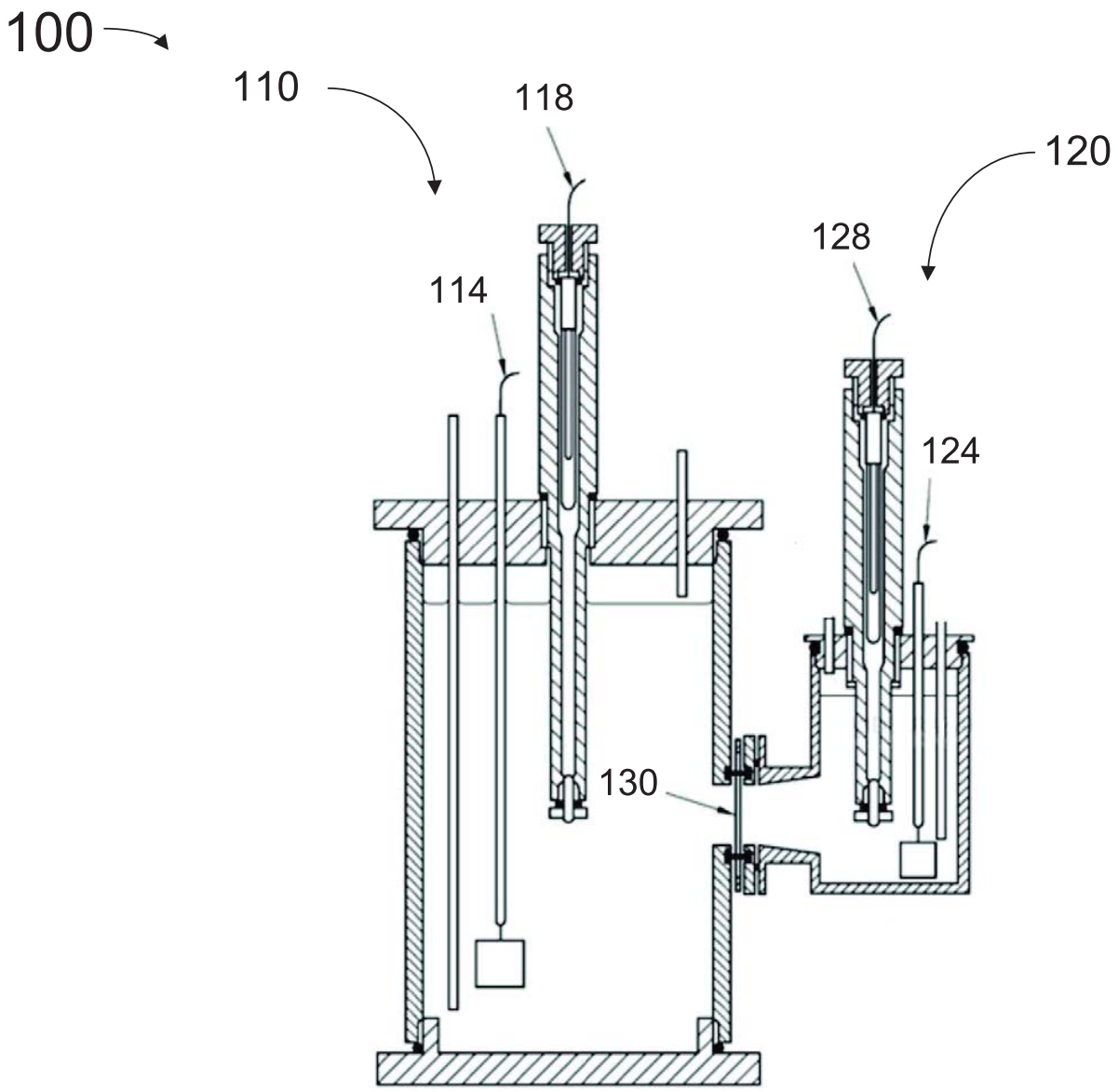


FIG. 1A
(Prior Art)

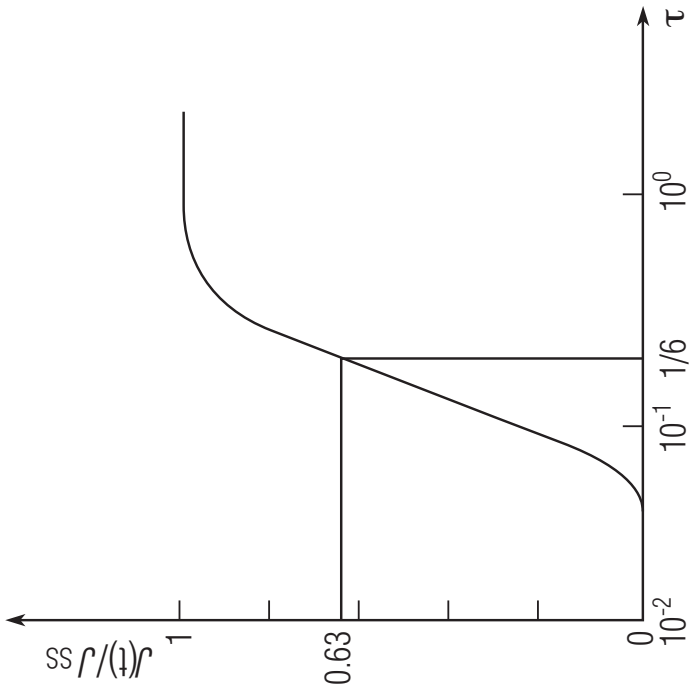


FIG. 1B
(Prior Art)

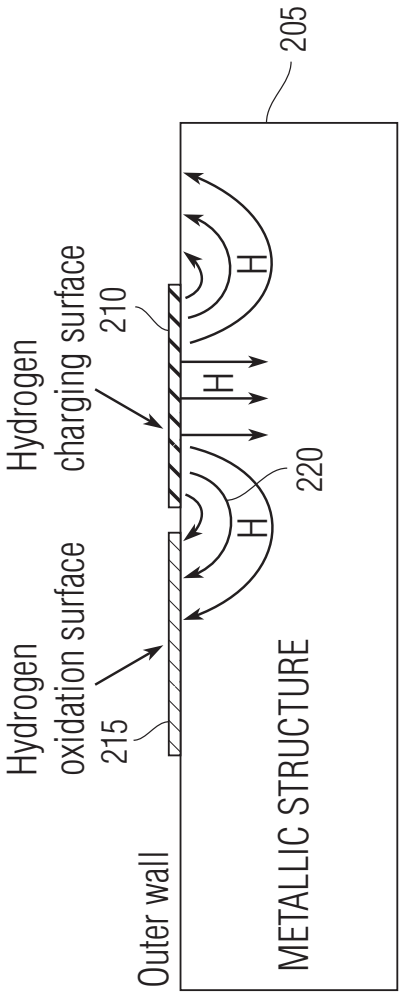


FIG. 2A

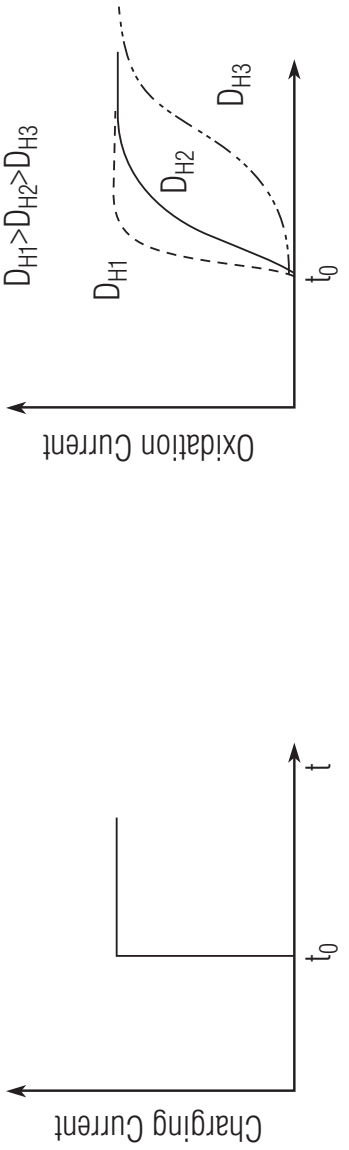
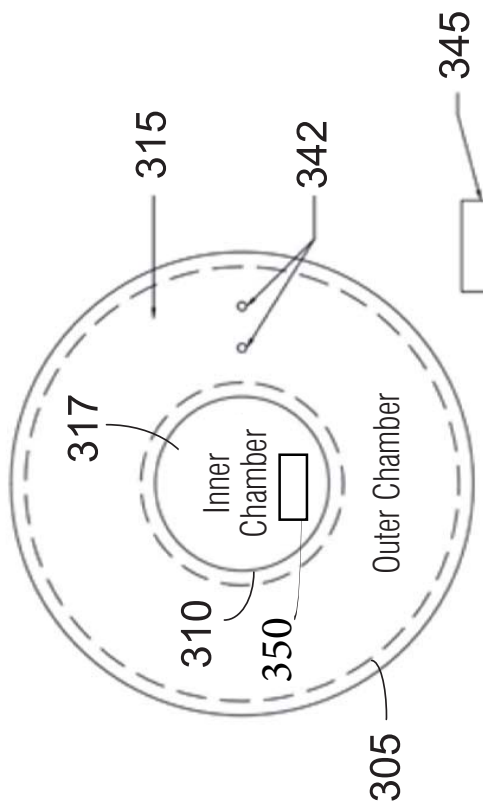


FIG. 2B

FIG. 2C


300

FIG. 3A


315
342
317
Inner Chamber
Outer Chamber
310
350
305

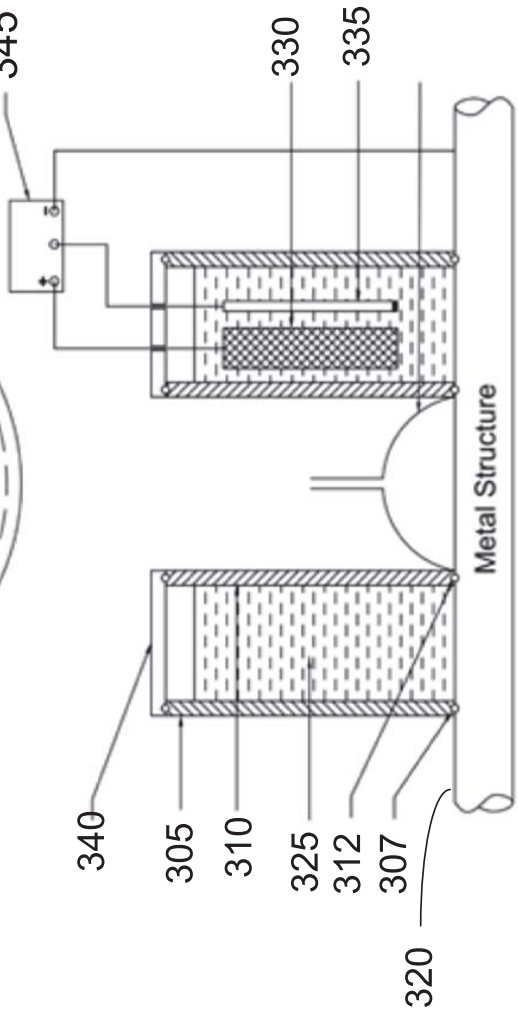

345
330
335
Metal Structure
340
305
310
325
312
307
320

FIG. 3B

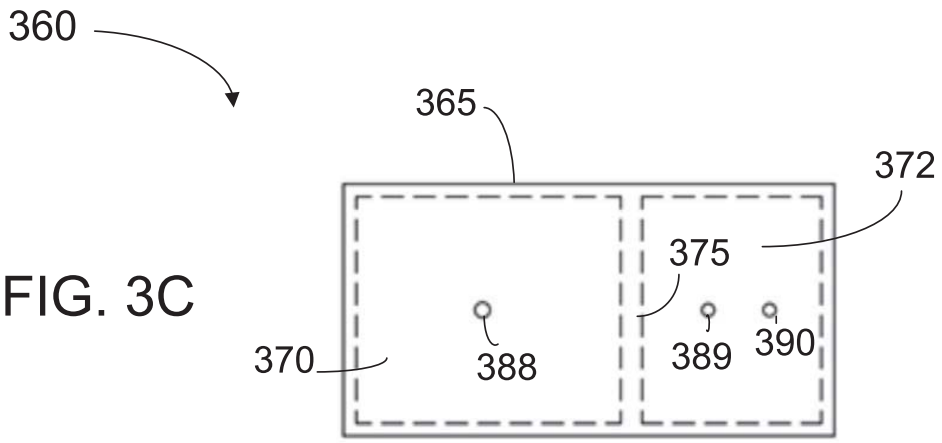

360
365
372
375
370
388
389
390

FIG. 3C

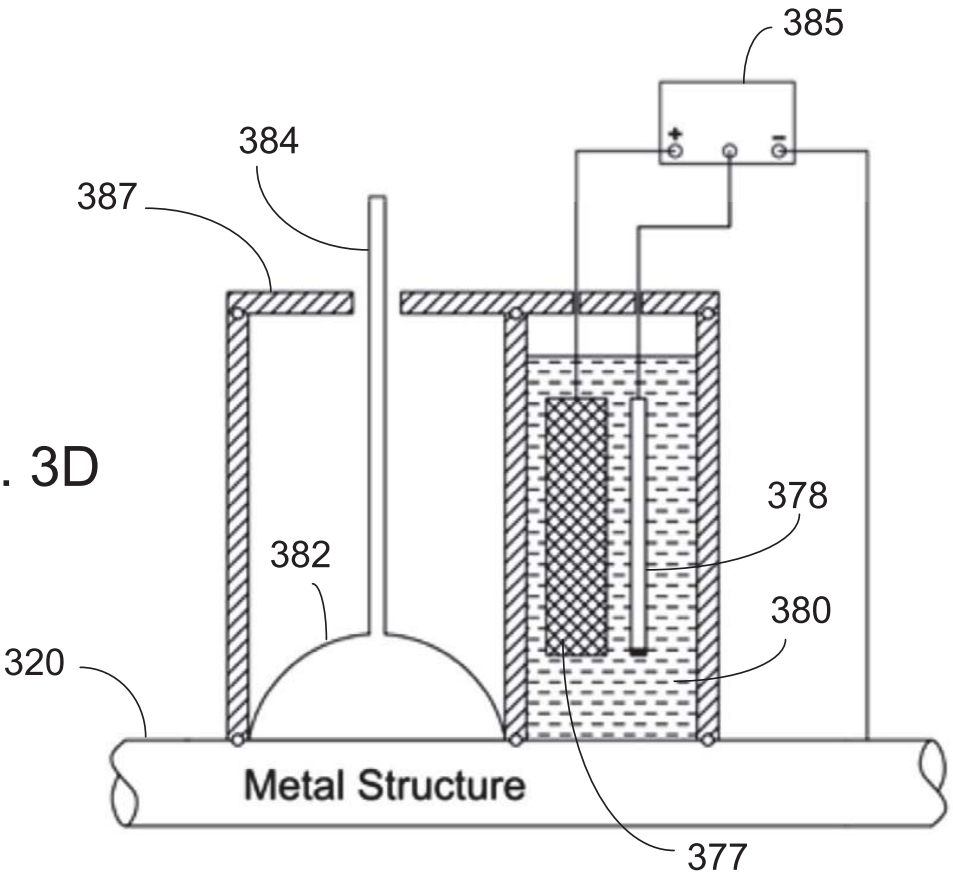

385
384
387
378
382
380
320
Metal Structure
377

FIG. 3D

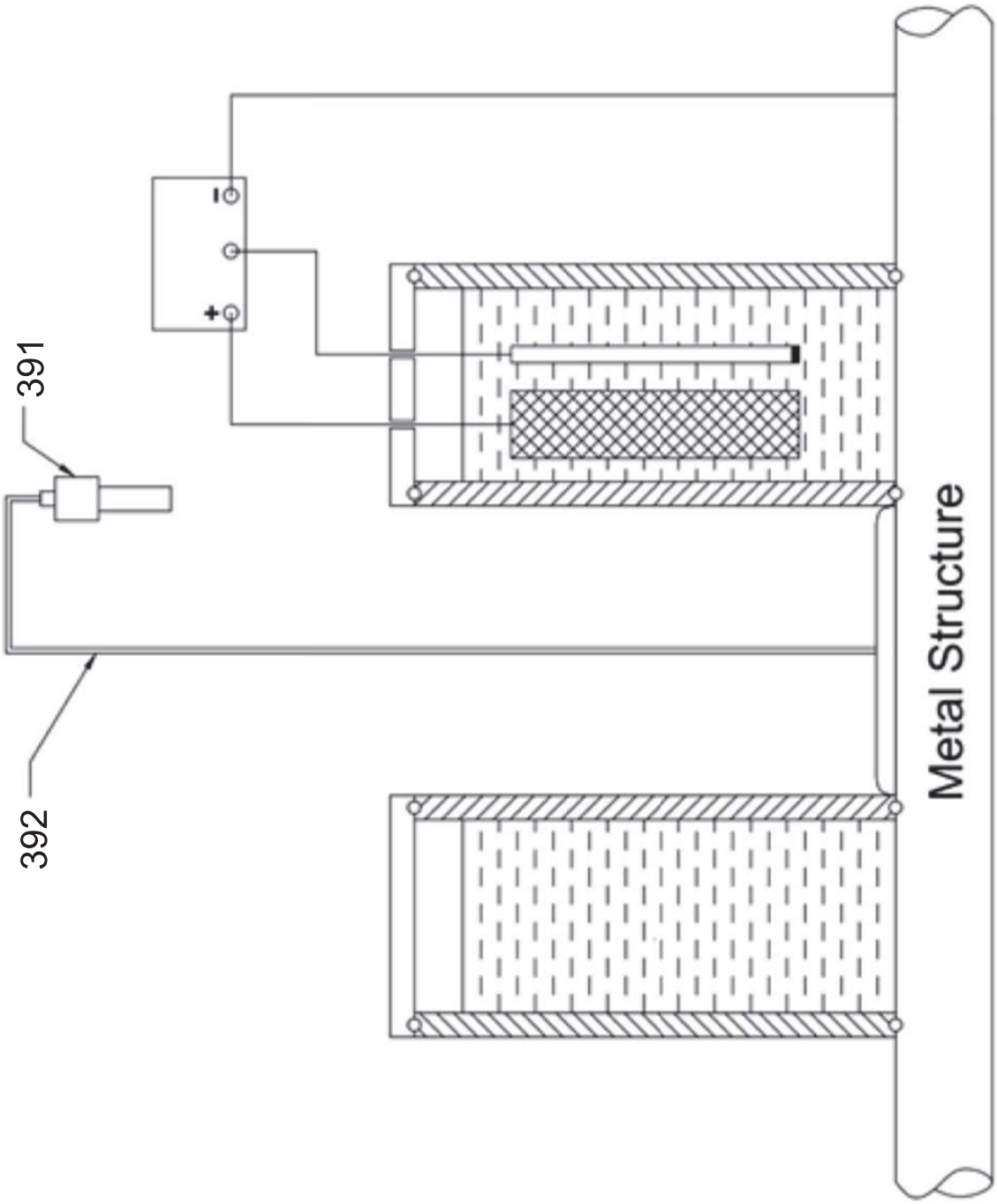


FIG. 3E

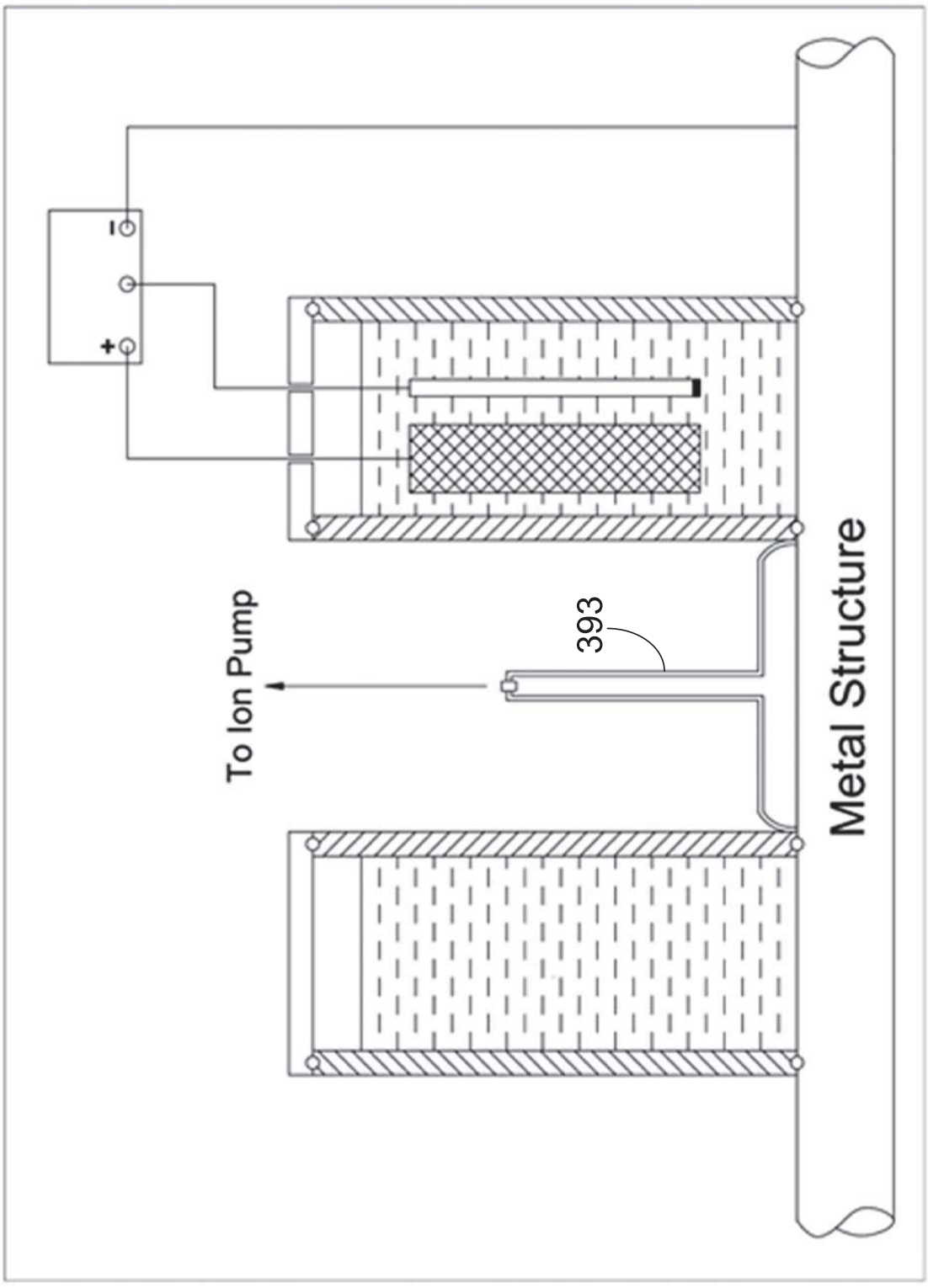


FIG. 3F

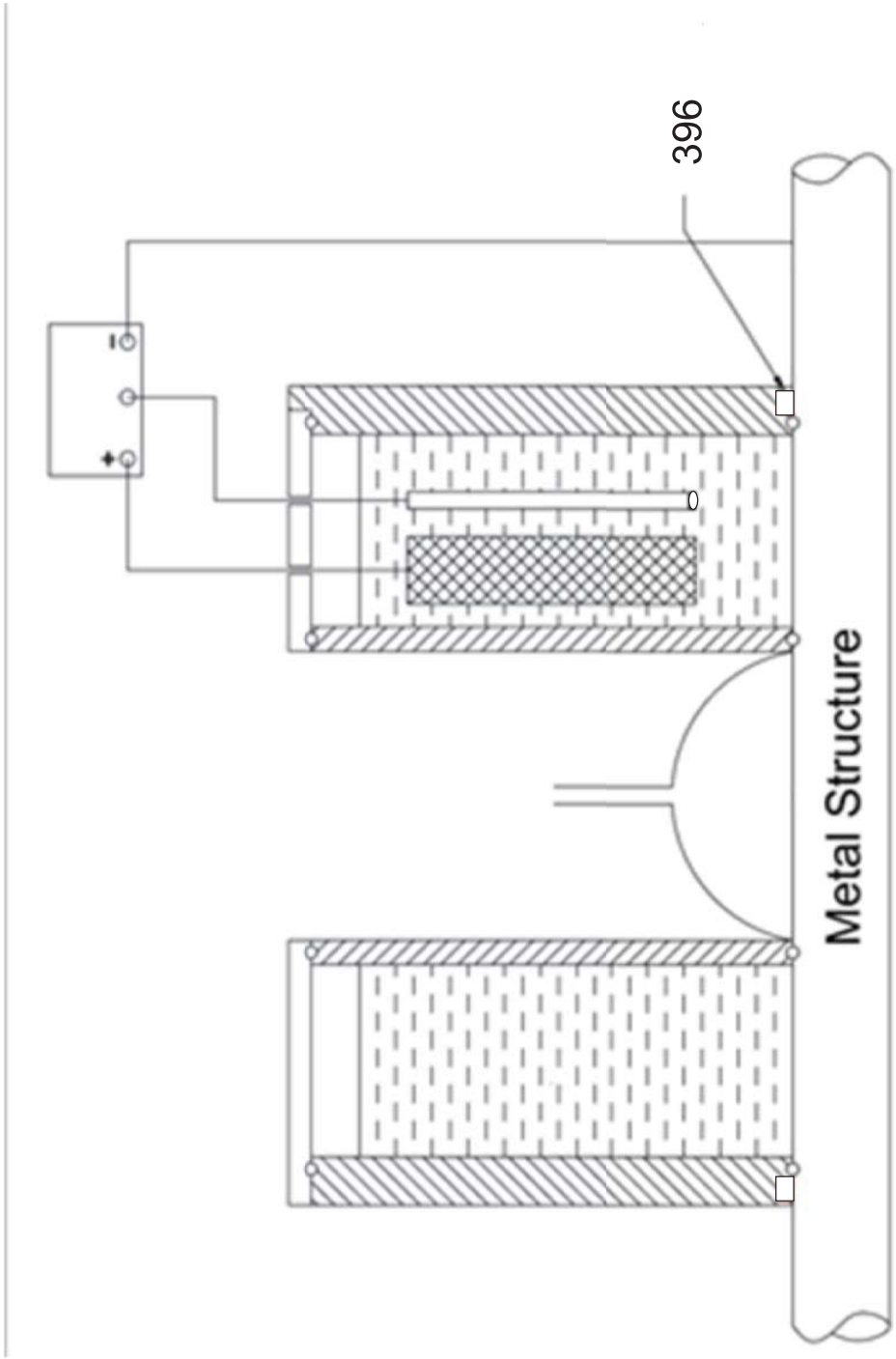


FIG. 3G

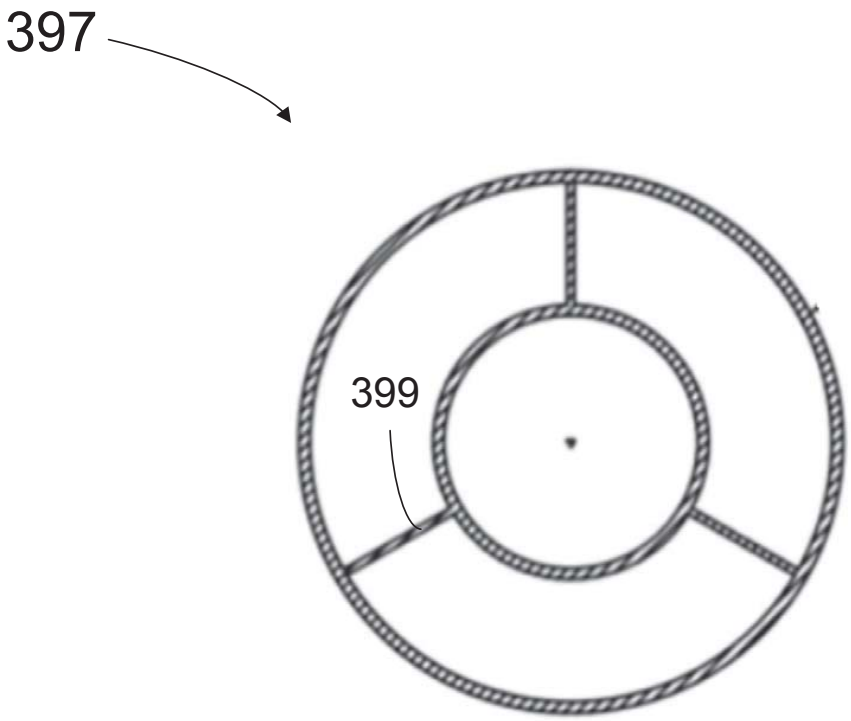


FIG. 3H

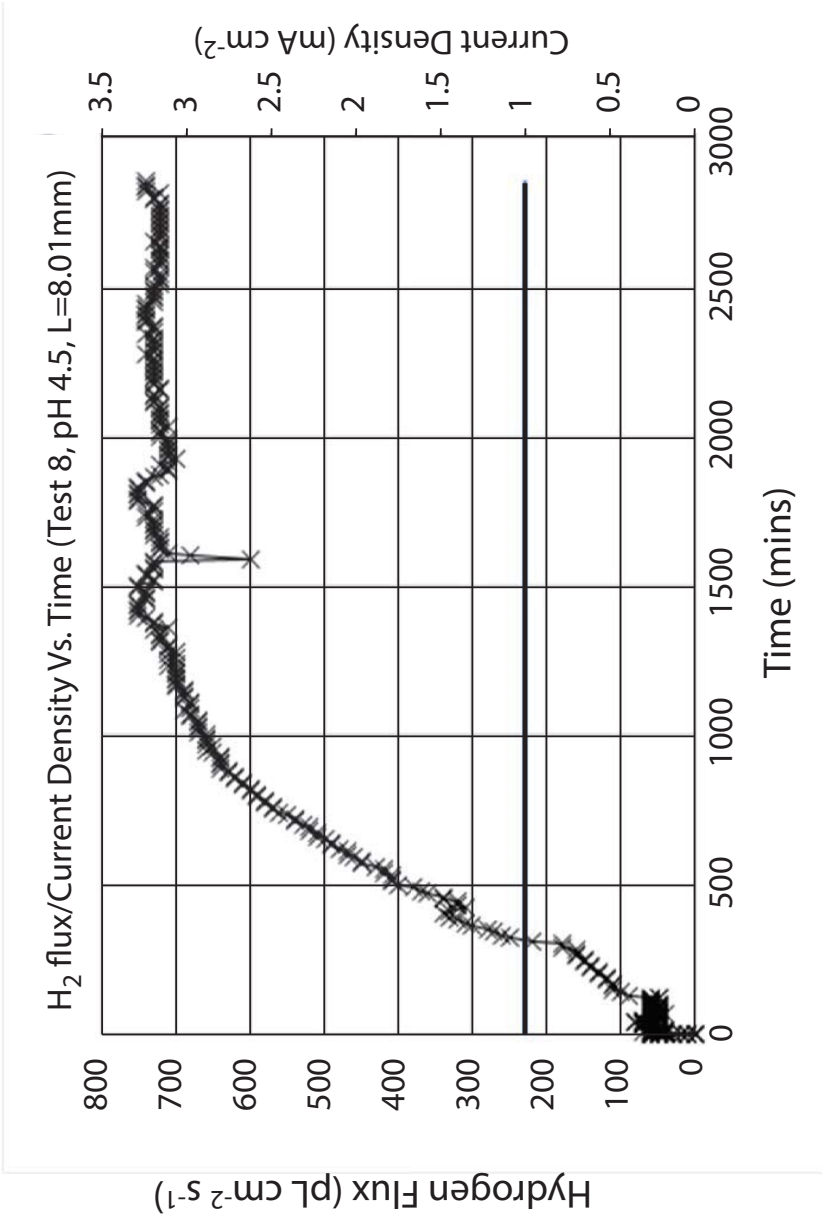

H_2 flux/Current Density Vs. Time (Test 8, pH 4.5, L=8.01mm)
Hydrogen Flux (pL cm^{-2} s^{-1})
Current Density (mA cm^{-2})
Time (mins)
0
100
200
300
400
500
600
700
800
0.5
1
1.5
2
2.5
3
3.5
500
1000
1500
2000
2500
3000

FIG. 3I

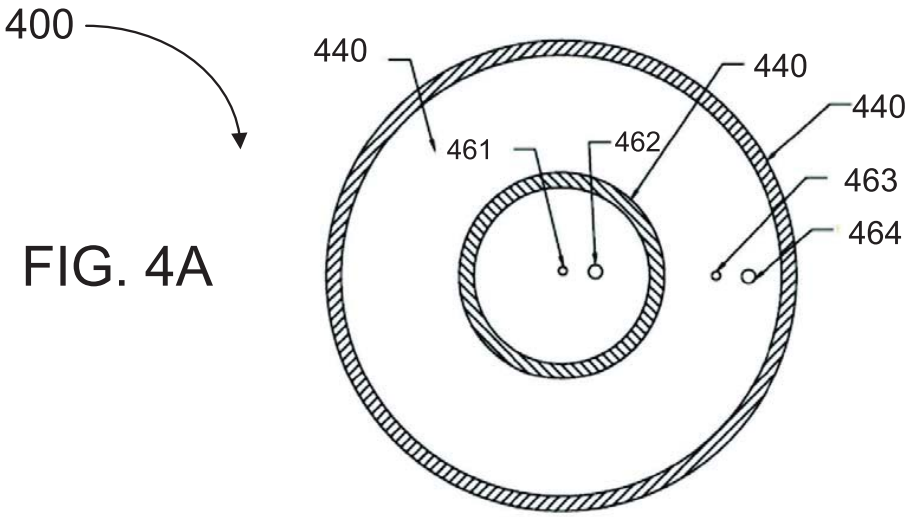

400
440
440
440
461
462
463
464

FIG. 4A

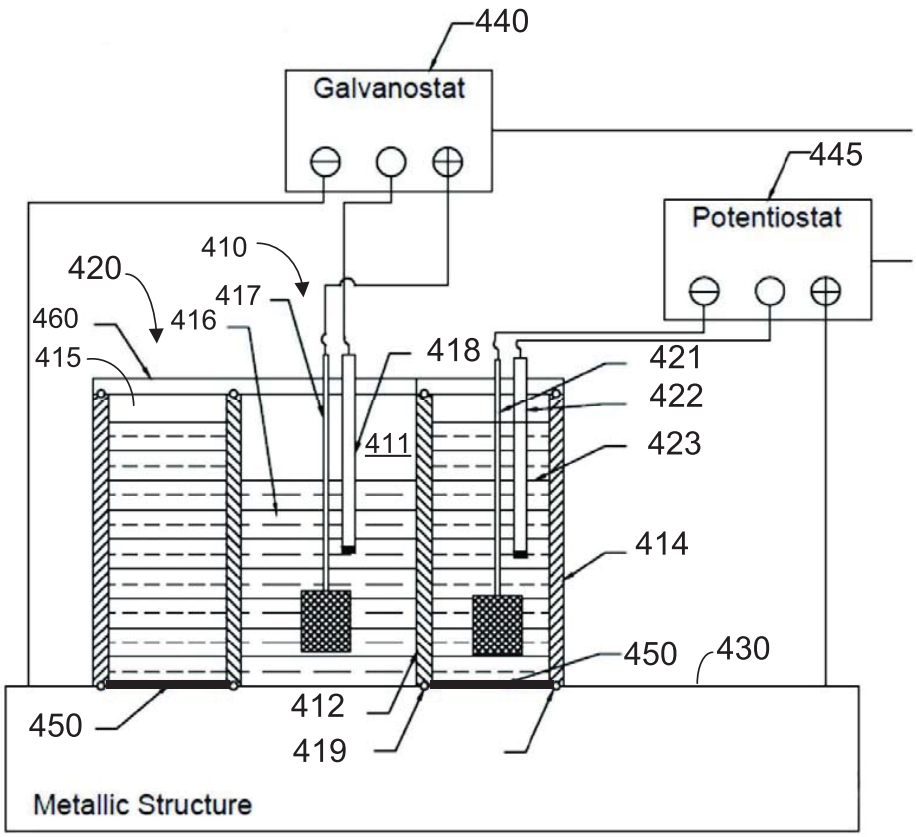

440
Galvanostat
445
Potentiostat
410
420
417
460
416
418
421
415
422
411
423
414
450
430
412
450
419
Metallic Structure

FIG. 4B

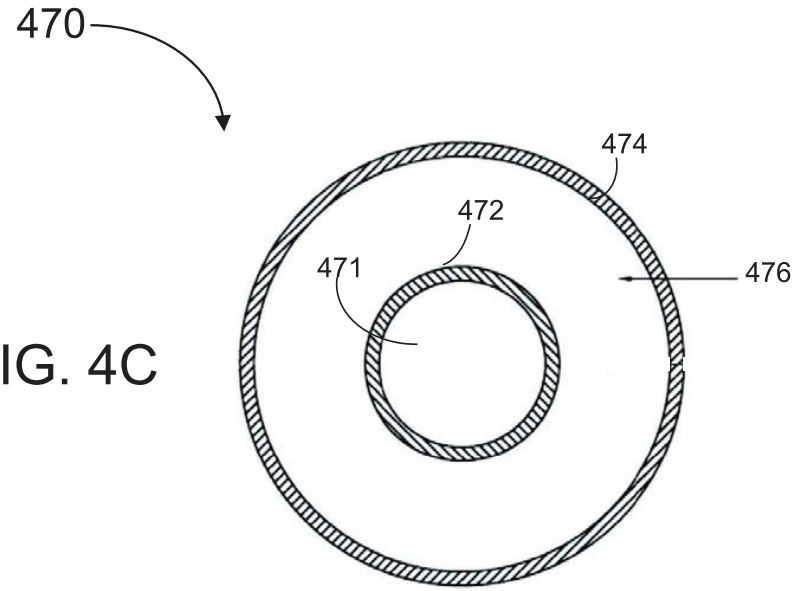

470
474
472
471
476

FIG. 4C

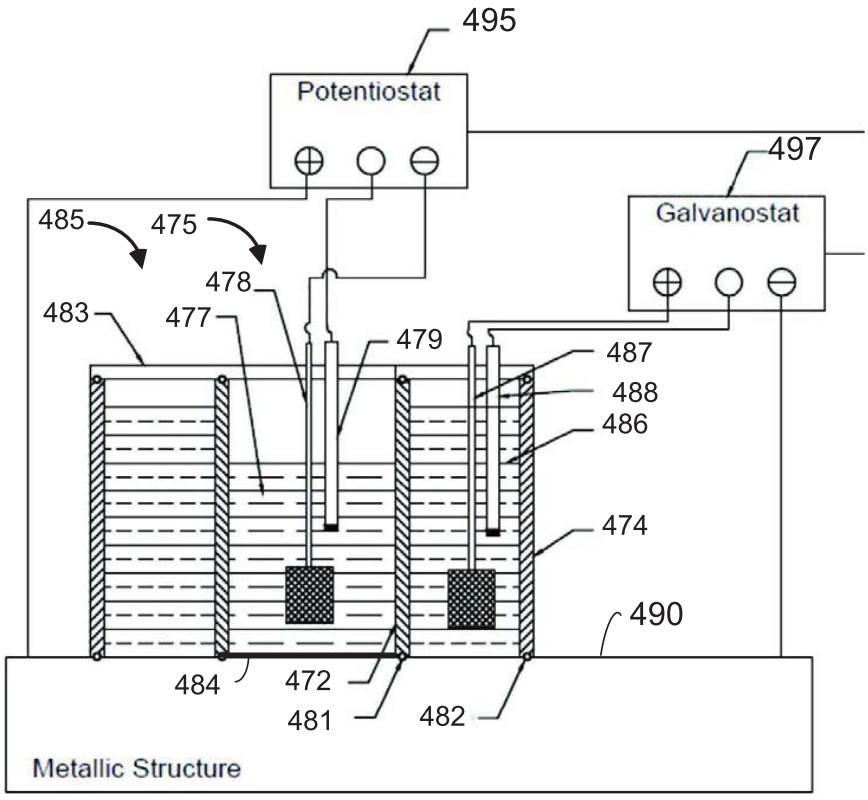

495
Potentiostat
497
Galvanostat
485
475
478
483
477
479
487
488
486
474
490
484
472
481
482
Metallic Structure

FIG. 4D

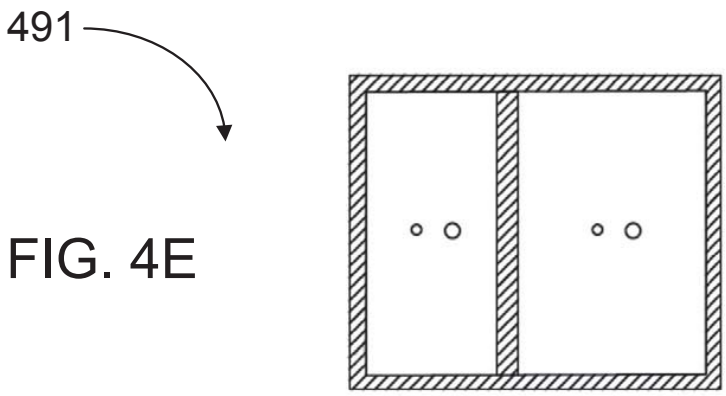


FIG. 4E

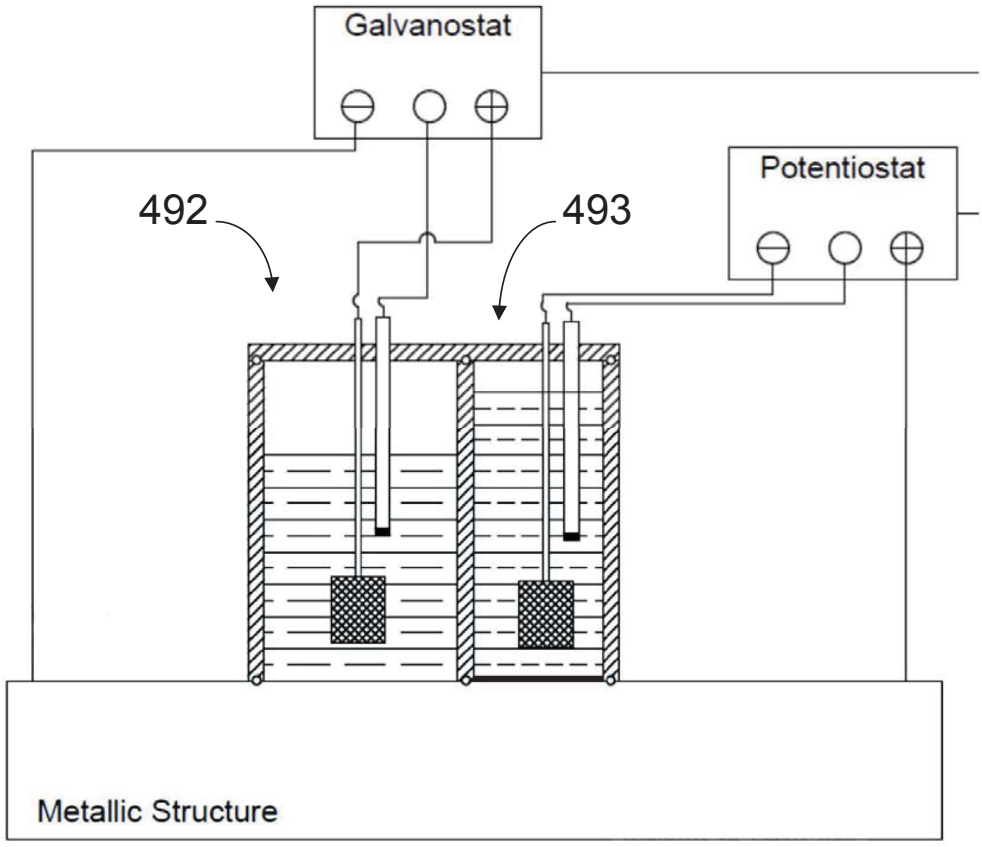


FIG. 4F

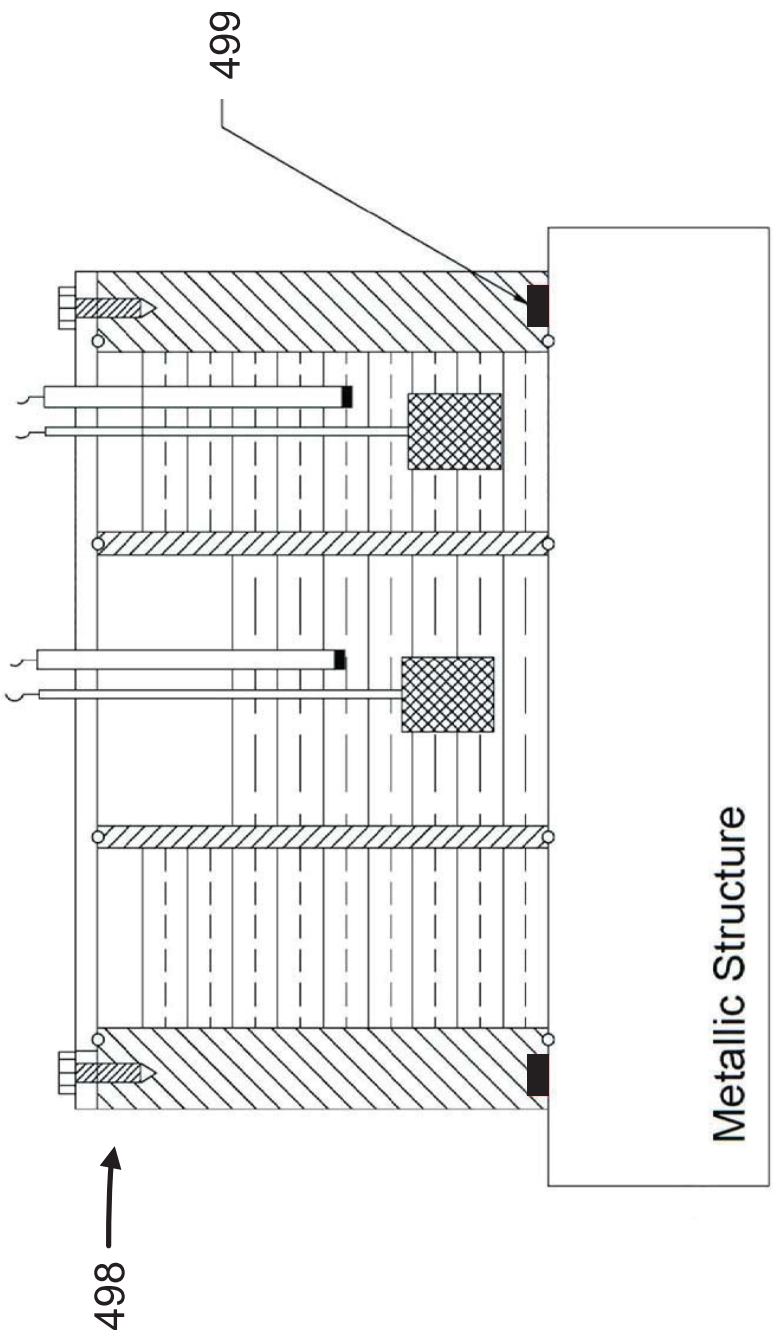


FIG. 4G

FIG. 5

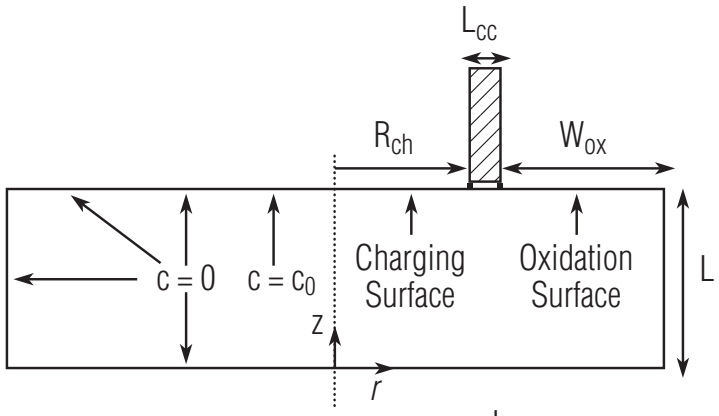
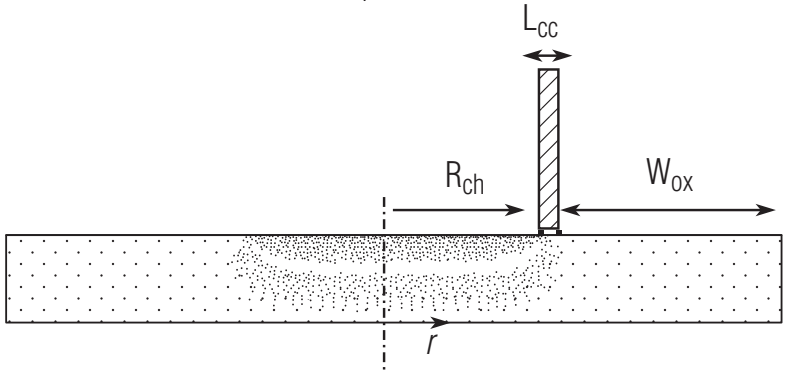


FIG. 6



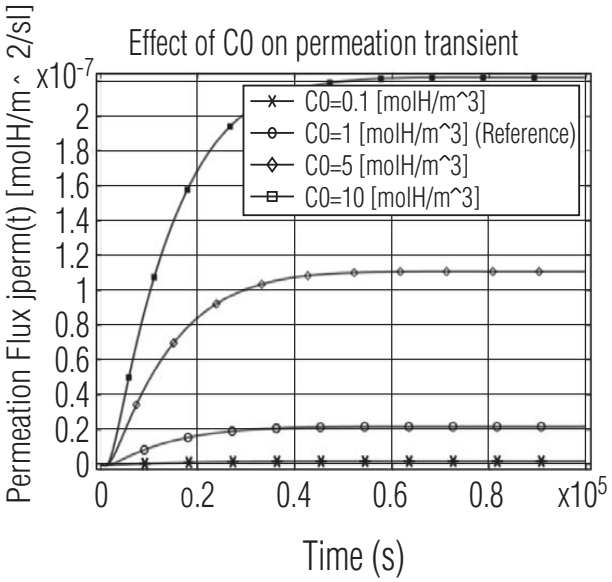


FIG. 7A

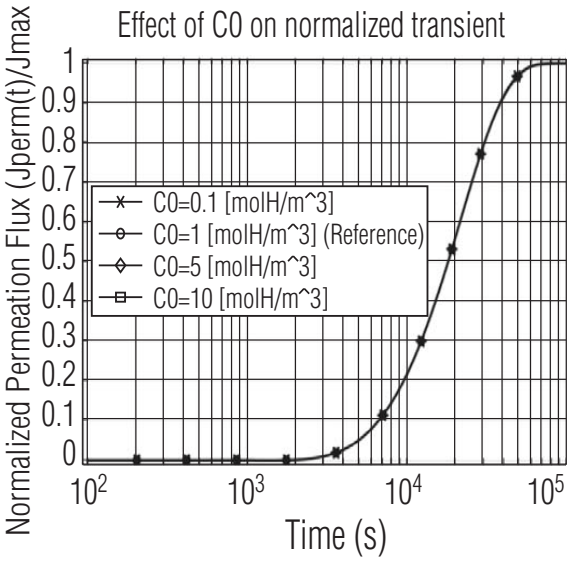


FIG. 7B

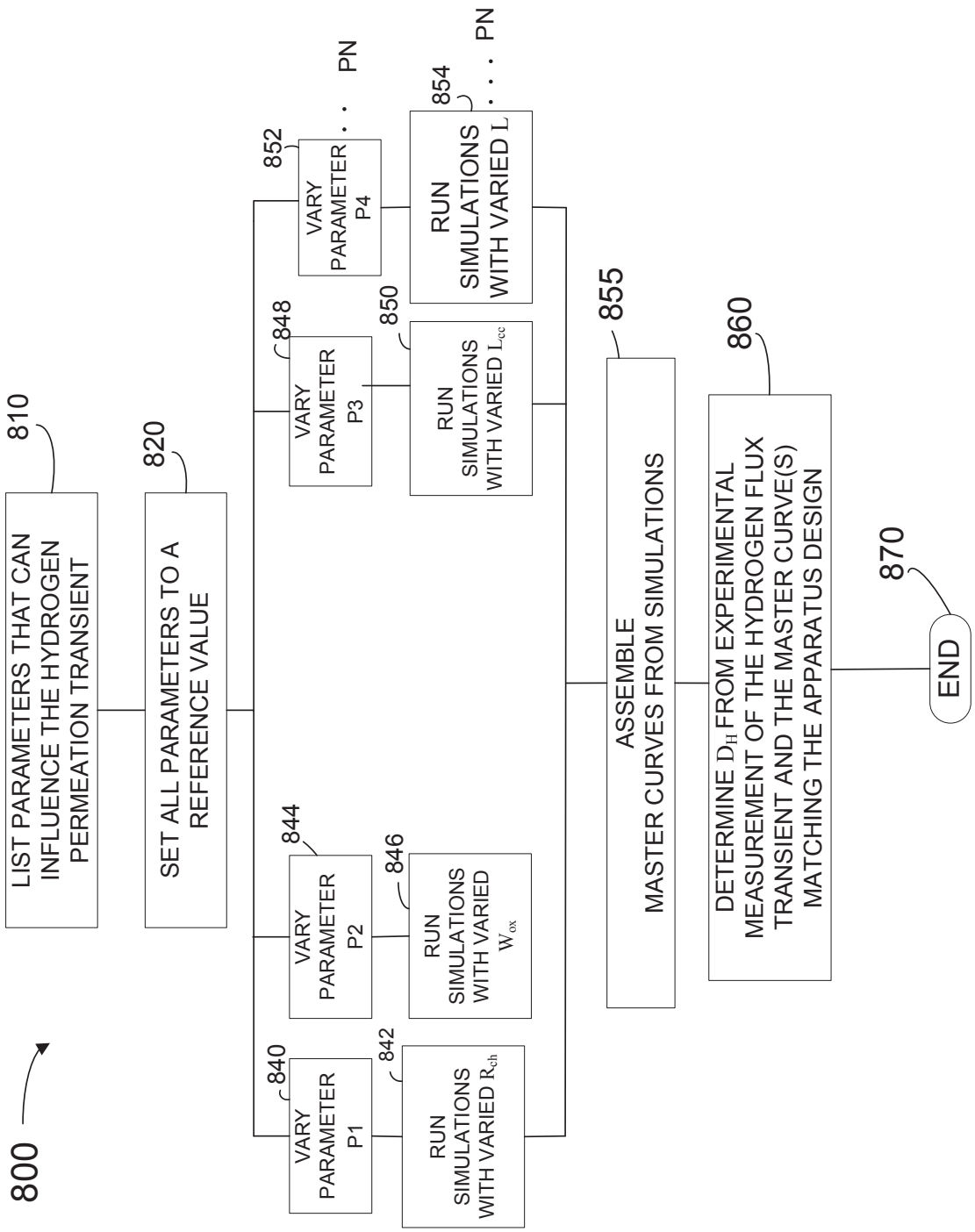

800
LIST PARAMETERS THAT CAN INFLUENCE THE HYDROGEN PERMEATION TRANSIENT
810
SET ALL PARAMETERS TO A REFERENCE VALUE
820
VARY PARAMETER P1
840
RUN SIMULATIONS WITH VARIED R_{ch}
842
VARY PARAMETER P2
844
RUN SIMULATIONS WITH VARIED W_{ox}
846
VARY PARAMETER P3
848
RUN SIMULATIONS WITH VARIED L_{cc}
850
VARY PARAMETER P4 . . PN
852
RUN SIMULATIONS WITH VARIED L . . . PN
854
ASSEMBLE MASTER CURVES FROM SIMULATIONS
855
DETERMINE D_H FROM EXPERIMENTAL MEASUREMENT OF THE HYDROGEN FLUX TRANSIENT AND THE MASTER CURVE(S) MATCHING THE APPARATUS DESIGN
860
END
870

FIG. 8

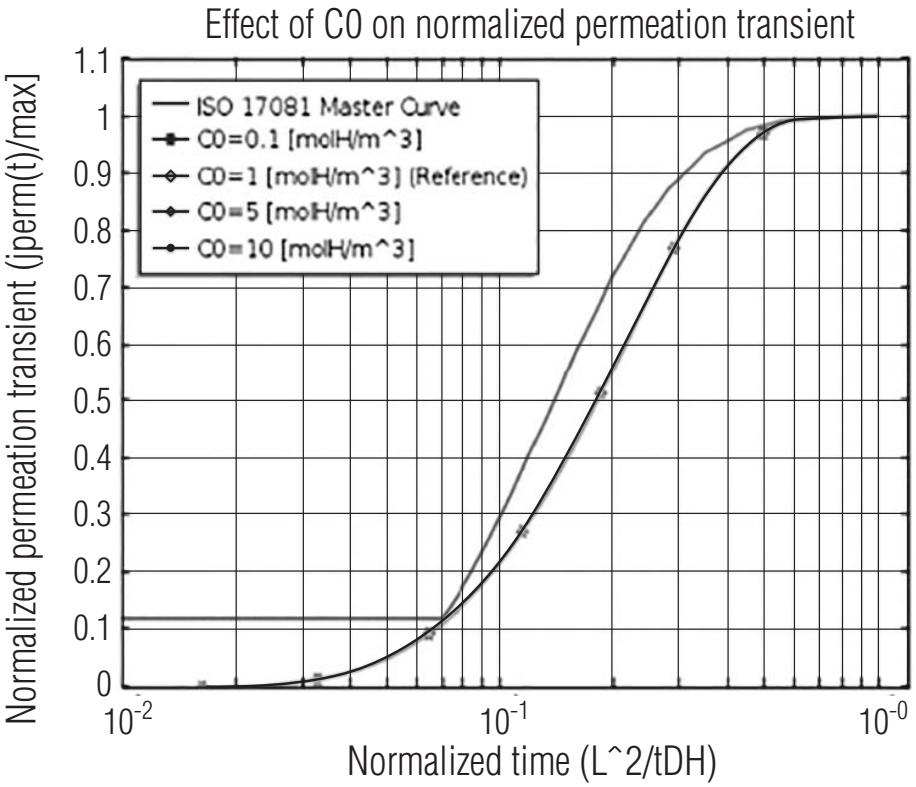

Effect of C0 on normalized permeation transient
ISO 17081 Master Curve
C0=0.1 [molH/m^3]
C0=1 [molH/m^3] (Reference)
C0=5 [molH/m^3]
C0=10 [molH/m^3]
Normalized permeation transient (jperm(t)/max)
Normalized time (L^2/tDH)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10-2
10-1
10-0

FIG. 9

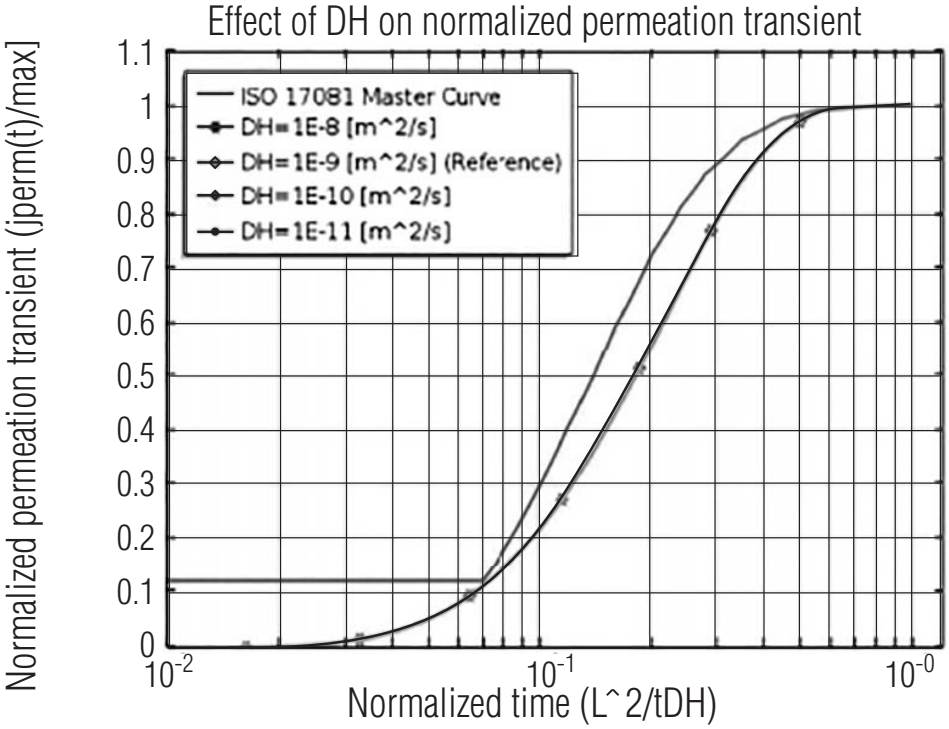

Effect of DH on normalized permeation transient
ISO 17081 Master Curve
DH=1E-8 [m^2/s]
DH=1E-9 [m^2/s] (Reference)
DH=1E-10 [m^2/s]
DH=1E-11 [m^2/s]
Normalized permeation transient (jperm(t)/max)
Normalized time (L^2/tDH)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10-2
10-1
10-0

FIG. 10

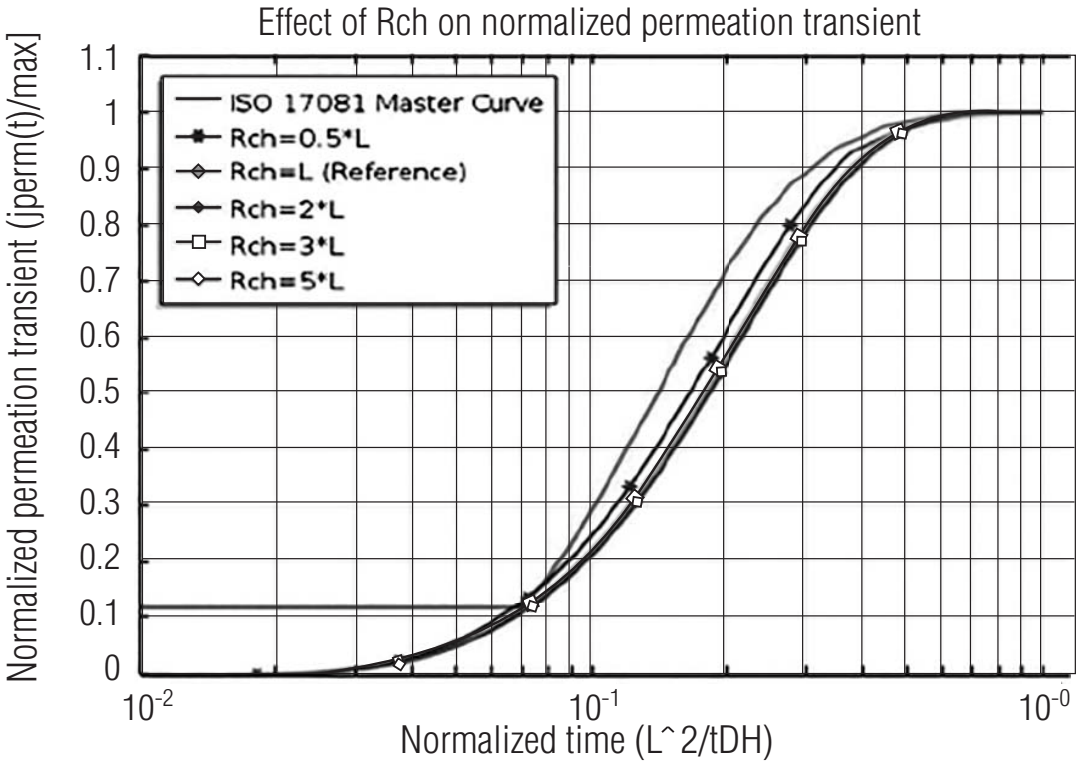

Effect of Rch on normalized permeation transient
Normalized permeation transient (jperm(t)/max]
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
ISO 17081 Master Curve
Rch=0.5*L
Rch=L (Reference)
Rch=2*L
Rch=3*L
Rch=5*L
10-2
10-1
10-0
Normalized time (L^ 2/tDH)

FIG. 11

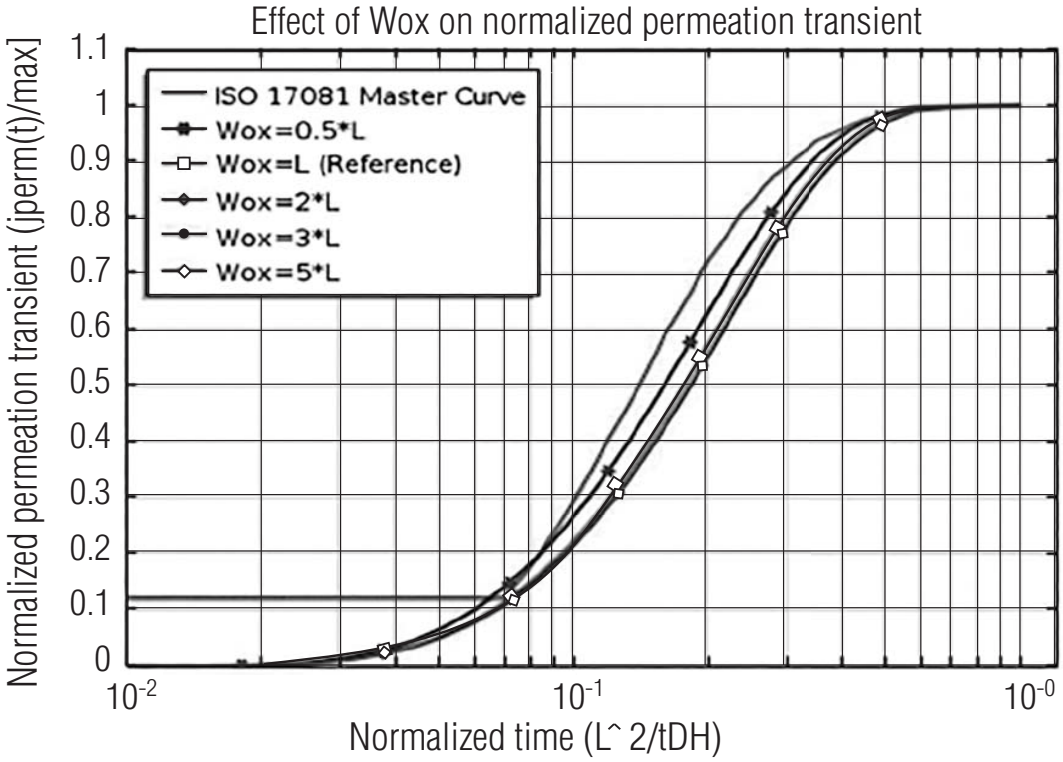

Effect of Wox on normalized permeation transient
Normalized permeation transient (jperm(t)/max]
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
ISO 17081 Master Curve
Wox=0.5*L
Wox=L (Reference)
Wox=2*L
Wox=3*L
Wox=5*L
10-2
10-1
10-0
Normalized time (L^ 2/tDH)

FIG. 12

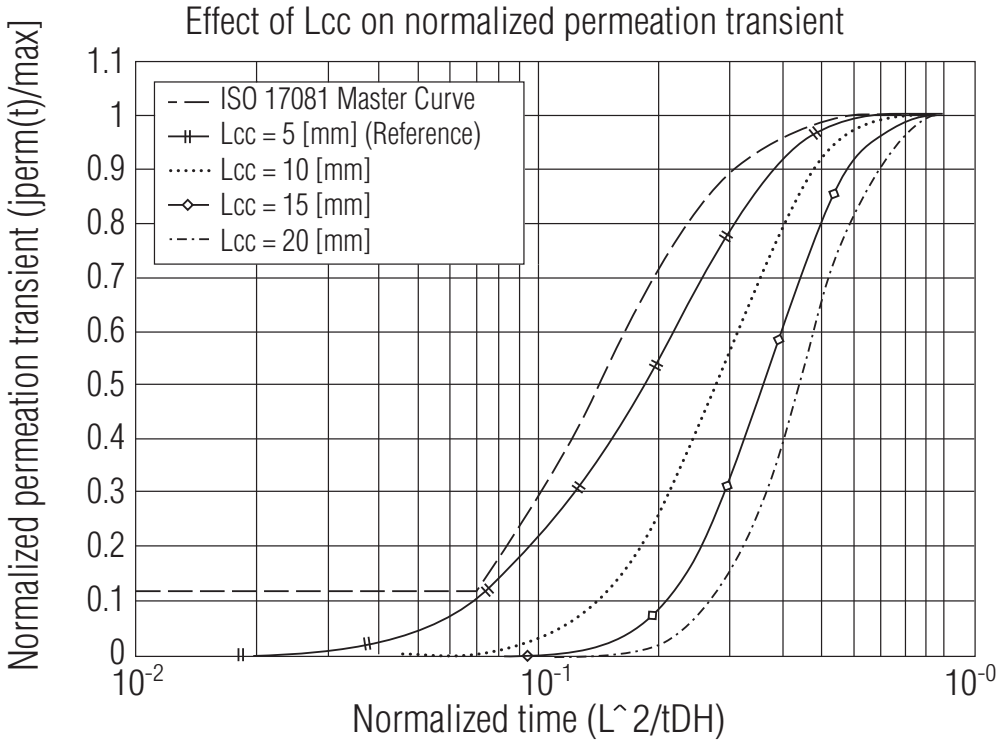

Effect of Lcc on normalized permeation transient
Normalized permeation transient (jperm(t)/max)
ISO 17081 Master Curve
Lcc = 5 [mm] (Reference)
Lcc = 10 [mm]
Lcc = 15 [mm]
Lcc = 20 [mm]
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10-2
10-1
10-0
Normalized time (L^2/tDH)

FIG. 13

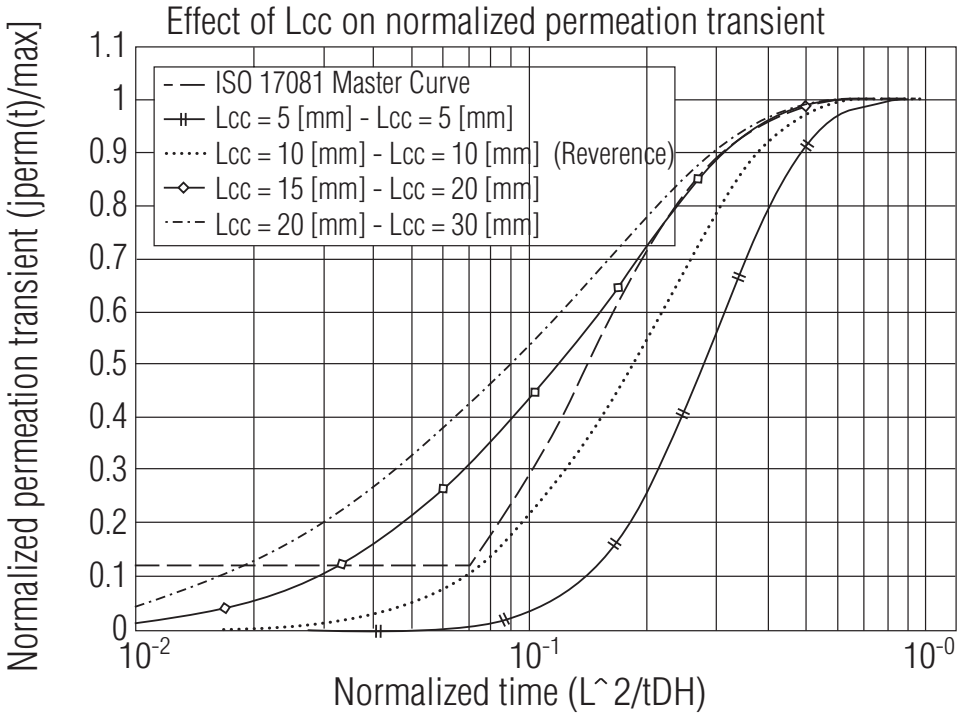

Effect of Lcc on normalized permeation transient
Normalized permeation transient (jperm(t)/max)
ISO 17081 Master Curve
Lcc = 5 [mm] - Lcc = 5 [mm]
Lcc = 10 [mm] - Lcc = 10 [mm] (Reverence)
Lcc = 15 [mm] - Lcc = 20 [mm]
Lcc = 20 [mm] - Lcc = 30 [mm]
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10-2
10-1
10-0
Normalized time (L^2/tDH)

FIG. 14

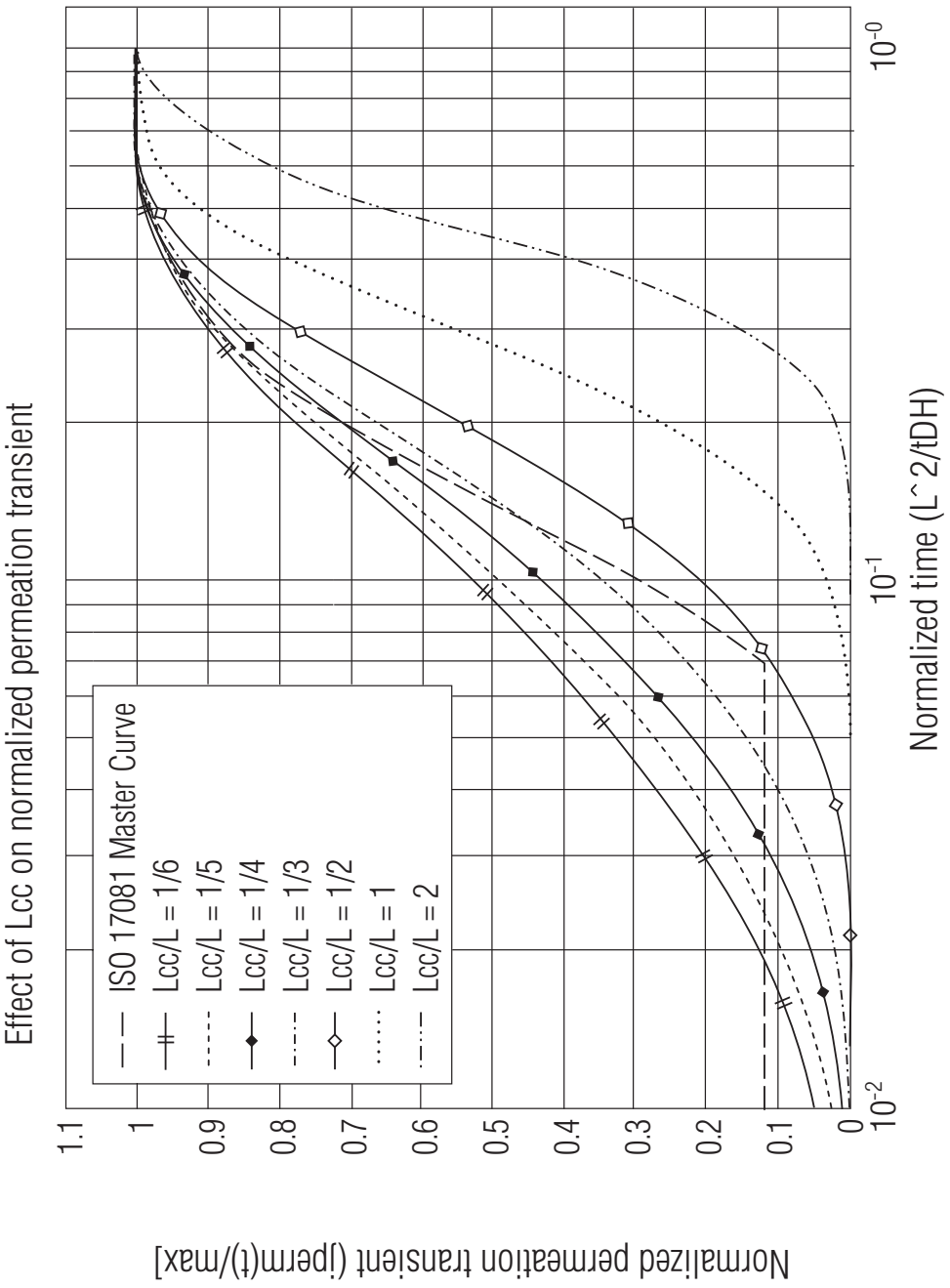

Effect of Lcc on normalized permeation transient
ISO 17081 Master Curve
Lcc/L = 1/6
Lcc/L = 1/5
Lcc/L = 1/4
Lcc/L = 1/3
Lcc/L = 1/2
Lcc/L = 1
Lcc/L = 2
Normalized permeation transient (jperm(t)/max]
Normalized time (L^2/tDH)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10-2
10-1
10-0

FIG. 15