FIG. 1

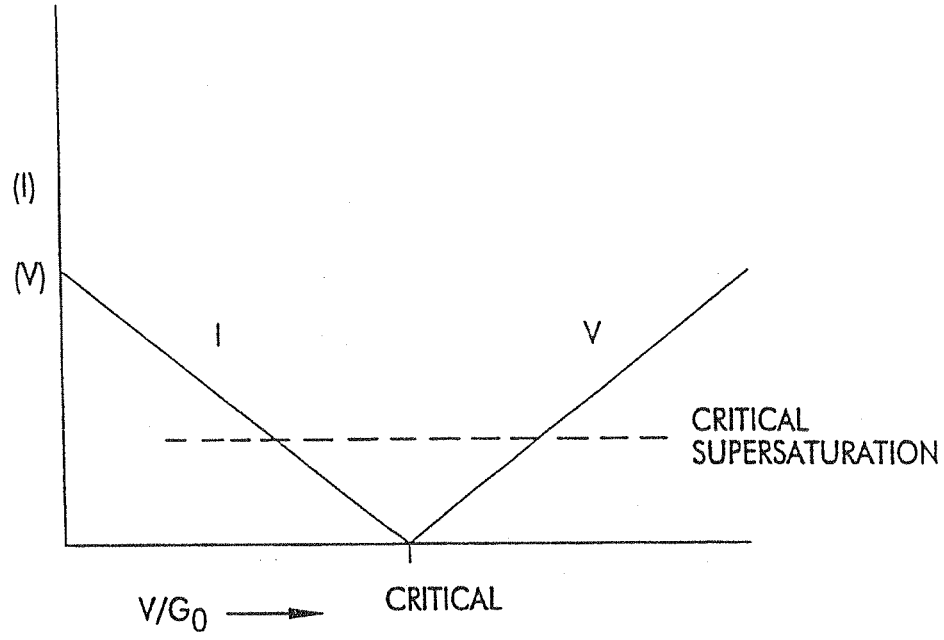

(I)
(V)
I
V
CRITICAL
SUPERSATURATION
V/G0
CRITICAL

FIG. 2

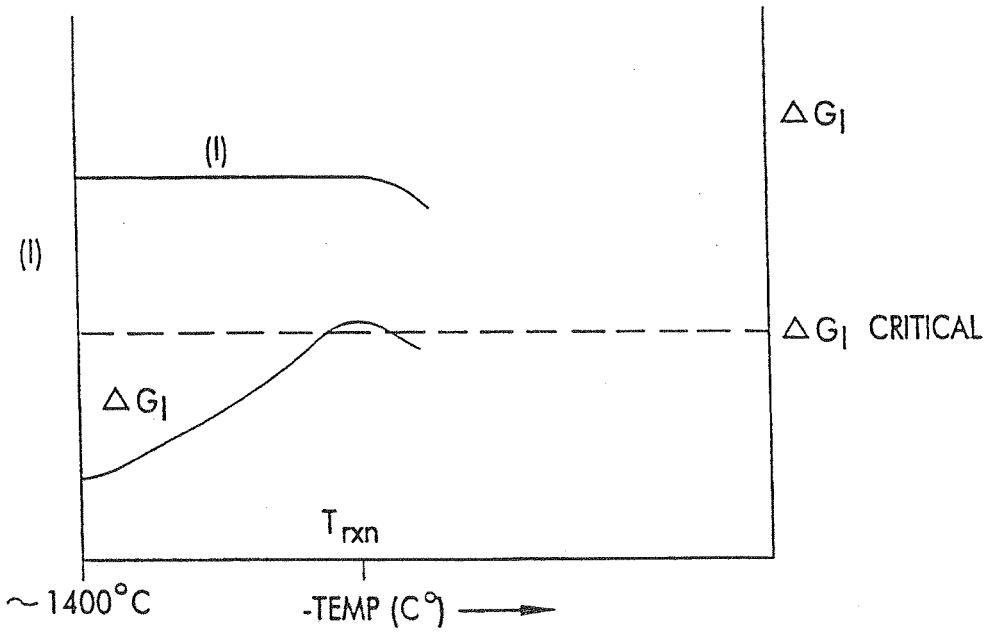

ΔGI
(I)
(I)
ΔGI CRITICAL
ΔGI
Trxn
~1400°C
-TEMP (C°)

FIG. 3

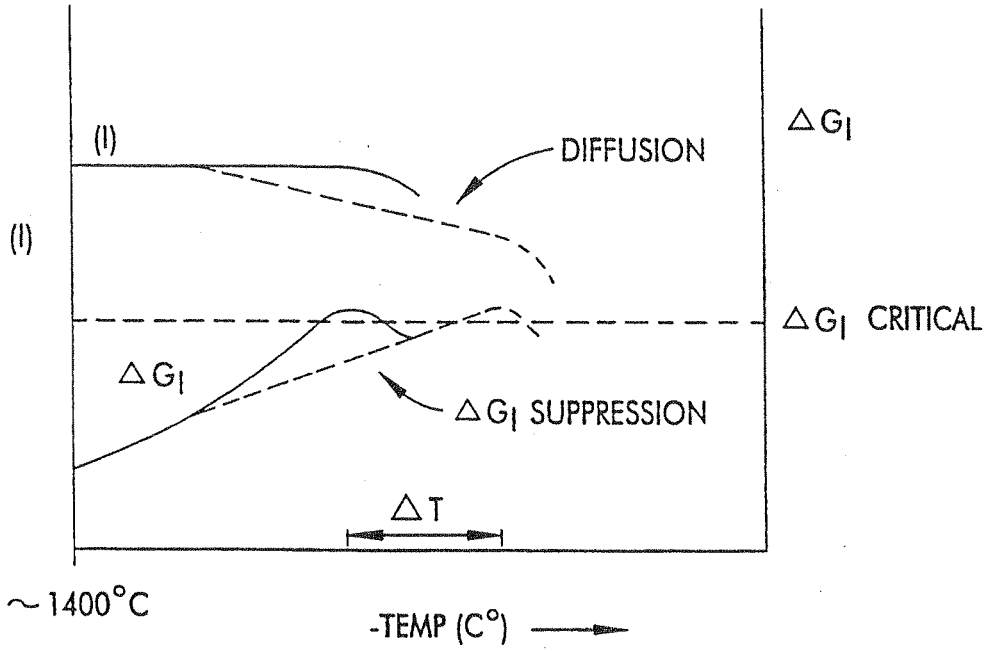

(I)
DIFFUSION
ΔG_I
(I)
ΔG_I CRITICAL
ΔG_I
ΔG_I SUPPRESSION
ΔT
~1400°C
-TEMP (C°)

FIG. 4

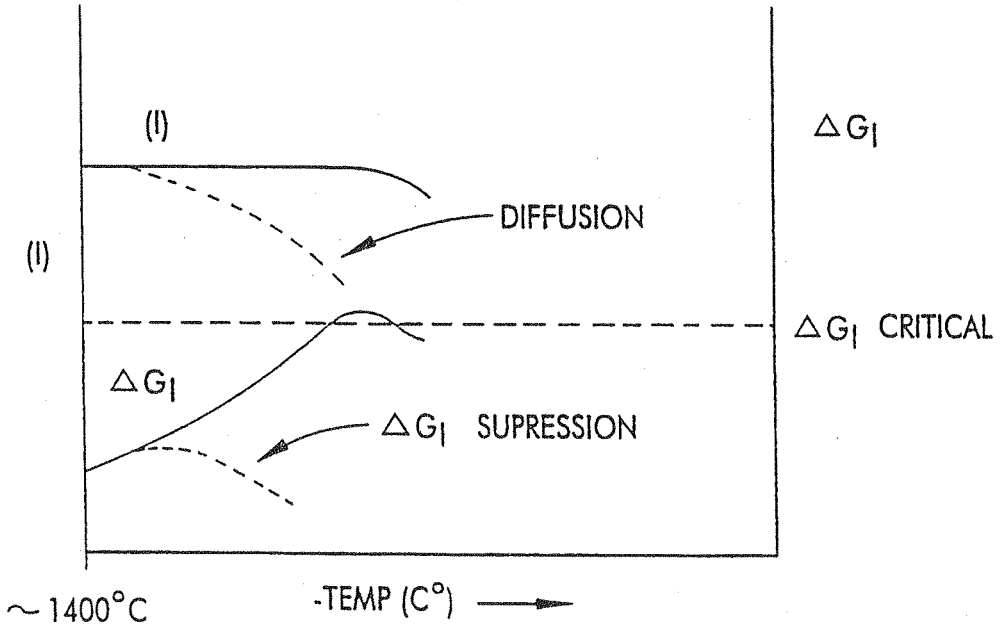

(I)
ΔG_I
DIFFUSION
(I)
ΔG_I CRITICAL
ΔG_I
ΔG_I SUPRESSION
~1400°C
-TEMP (C°)

FIG. 5

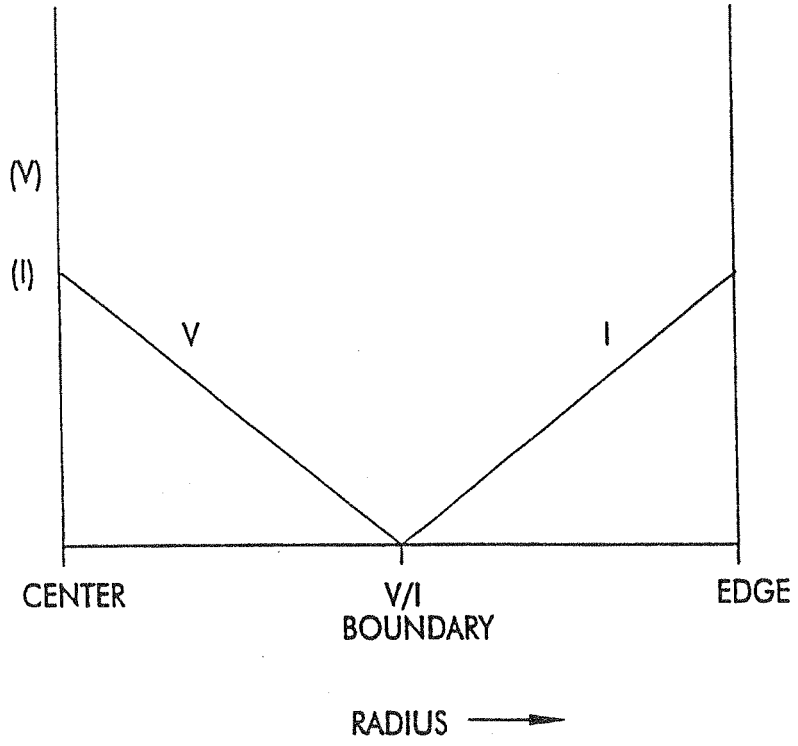

(V)
(I)
V
I
CENTER
V/I
BOUNDARY
EDGE
RADIUS

FIG. 6

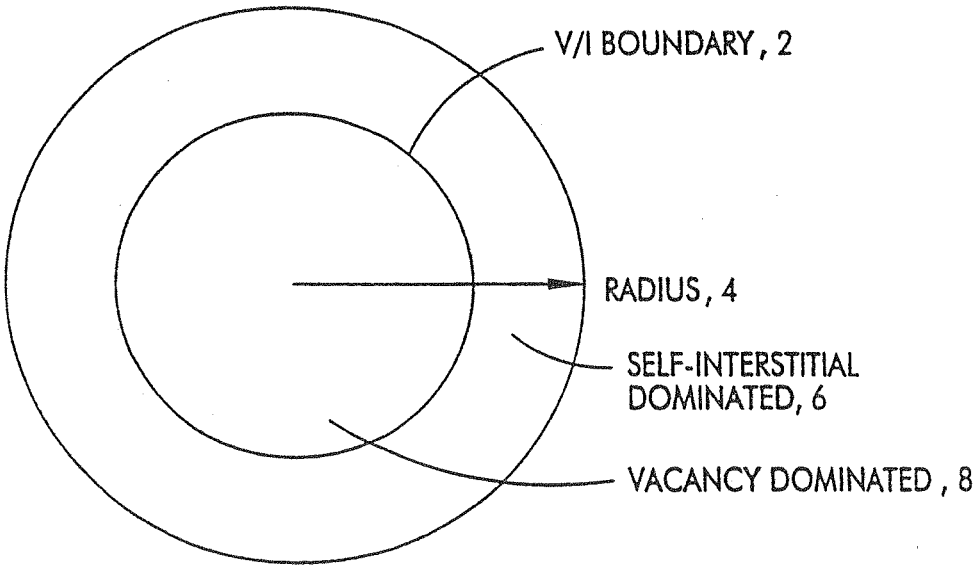

V/I BOUNDARY, 2
RADIUS, 4
SELF-INTERSTITIAL
DOMINATED, 6
VACANCY DOMINATED , 8

FIG.7A

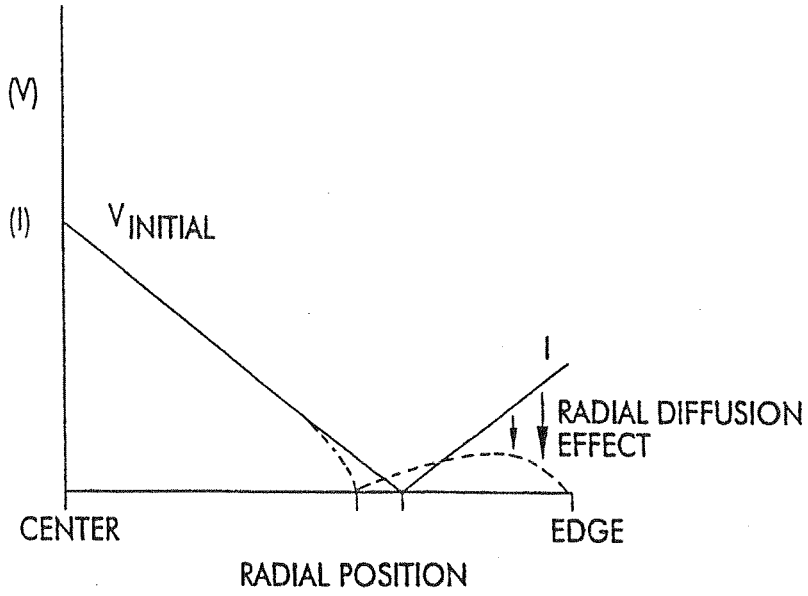

(V)
(I)
$V_{INITIAL}$
I
RADIAL DIFFUSION EFFECT
CENTER
EDGE
RADIAL POSITION

FIG.7B

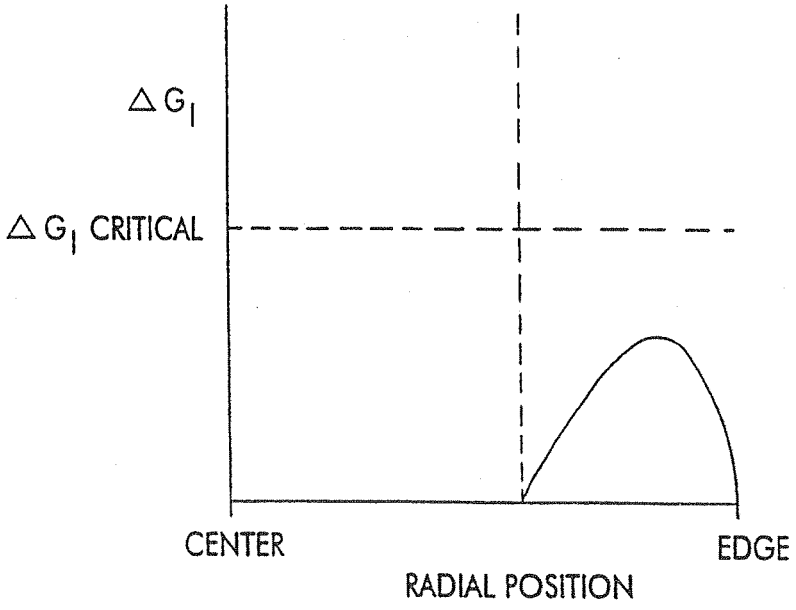

ΔG_I
ΔG_I CRITICAL
CENTER
EDGE
RADIAL POSITION

FIG. 7C

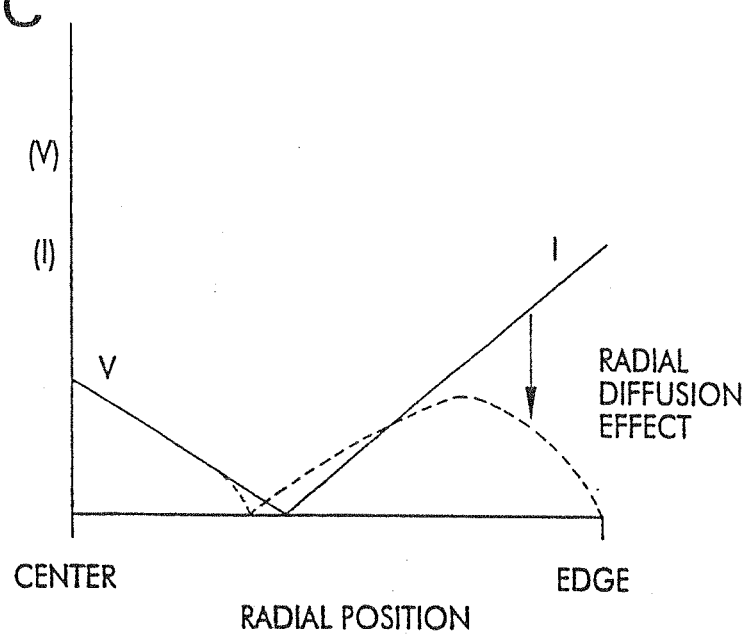

(V)
(I)
I
V
RADIAL
DIFFUSION
EFFECT
CENTER
EDGE
RADIAL POSITION

FIG. 7D

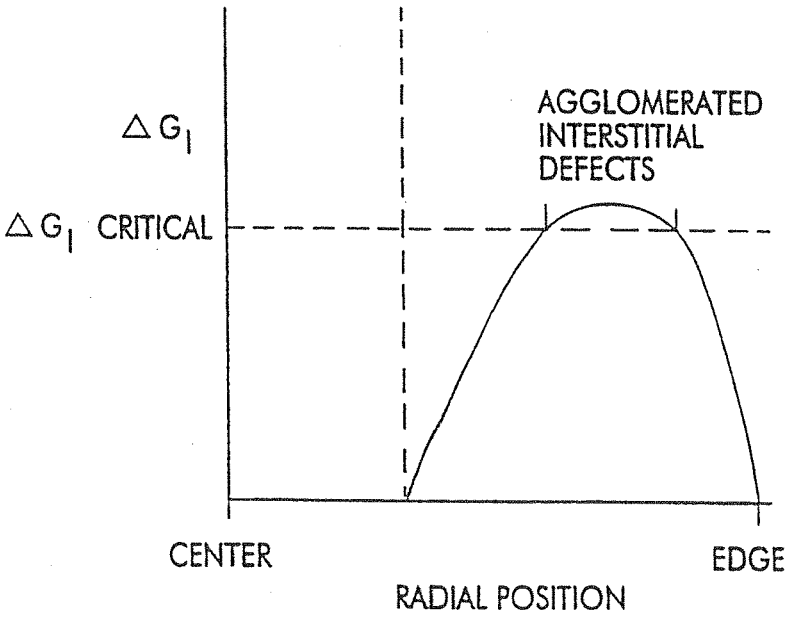

ΔG_I
ΔG_I CRITICAL
AGGLOMERATED
INTERSTITIAL
DEFECTS
CENTER
EDGE
RADIAL POSITION

FIG. 7E

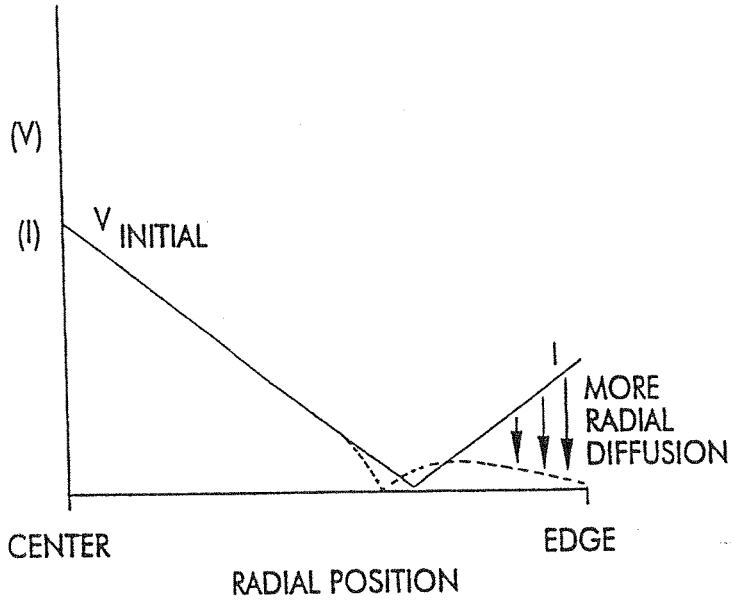

(V)
(I)
V INITIAL
I
MORE
RADIAL
DIFFUSION
CENTER
EDGE
RADIAL POSITION

FIG. 7F

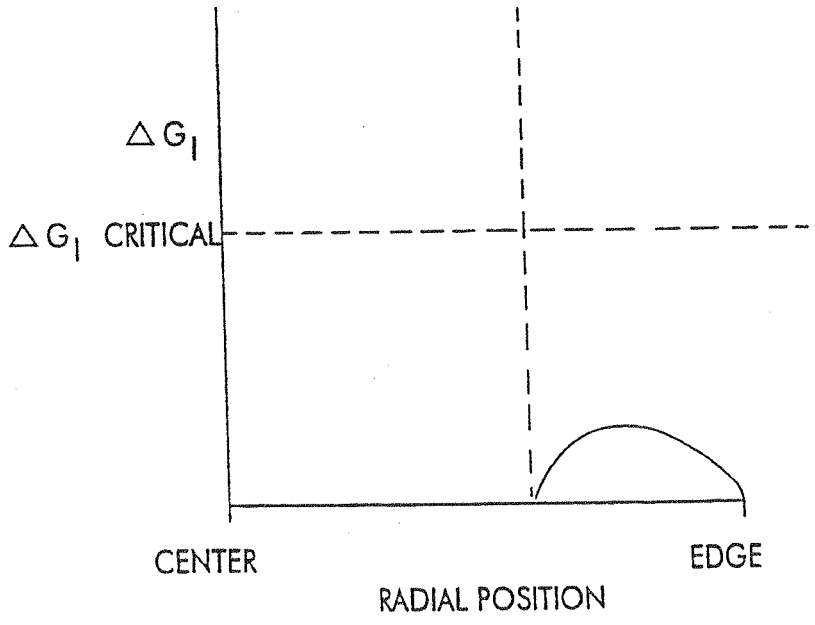

△G1
△G1 CRITICAL
CENTER
EDGE
RADIAL POSITION

FIG.7G

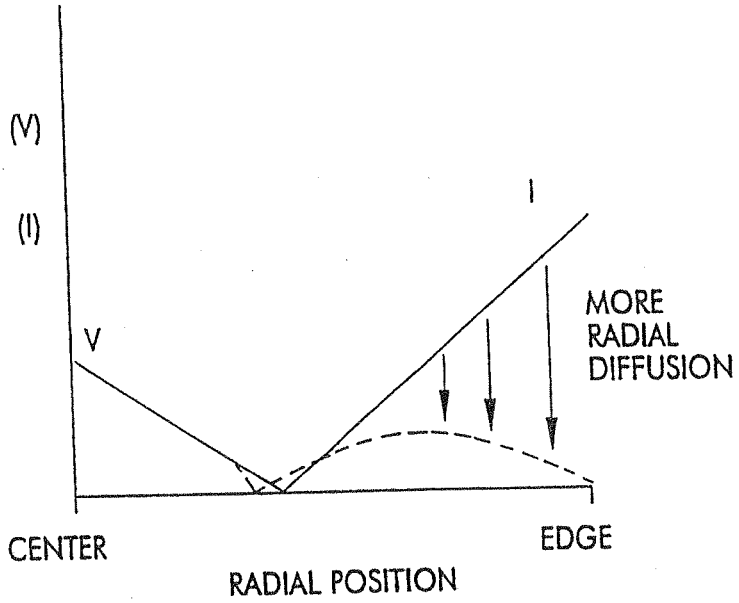

(V)
(I)
I
V
MORE
RADIAL
DIFFUSION
CENTER
EDGE
RADIAL POSITION

FIG.7H

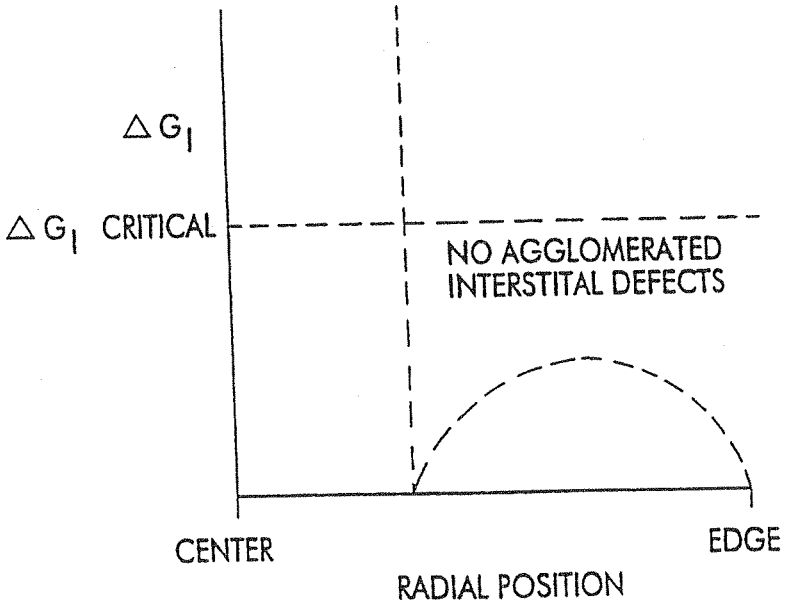

ΔG_I
ΔG_I CRITICAL
NO AGGLOMERATED
INTERSTITAL DEFECTS
CENTER
EDGE
RADIAL POSITION

FIG.7I

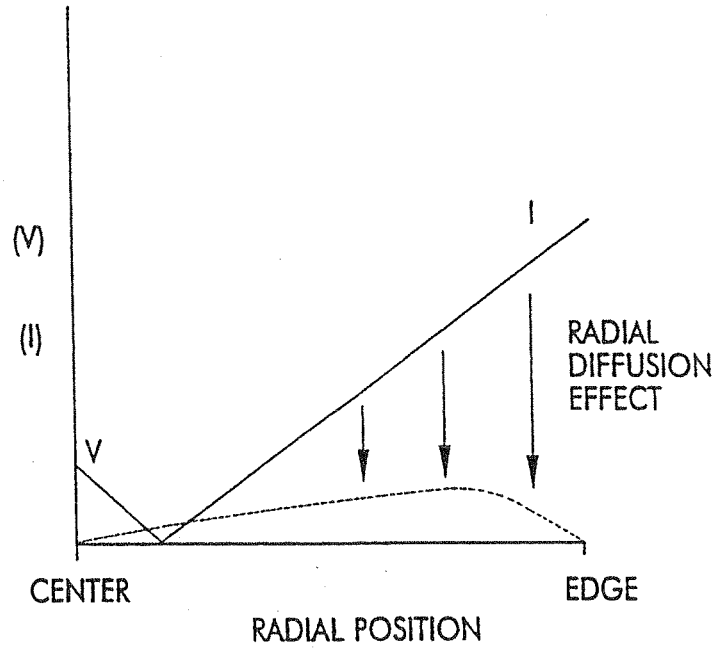

(V)
(I)
I
V
RADIAL
DIFFUSION
EFFECT
CENTER
EDGE
RADIAL POSITION

FIG.7J

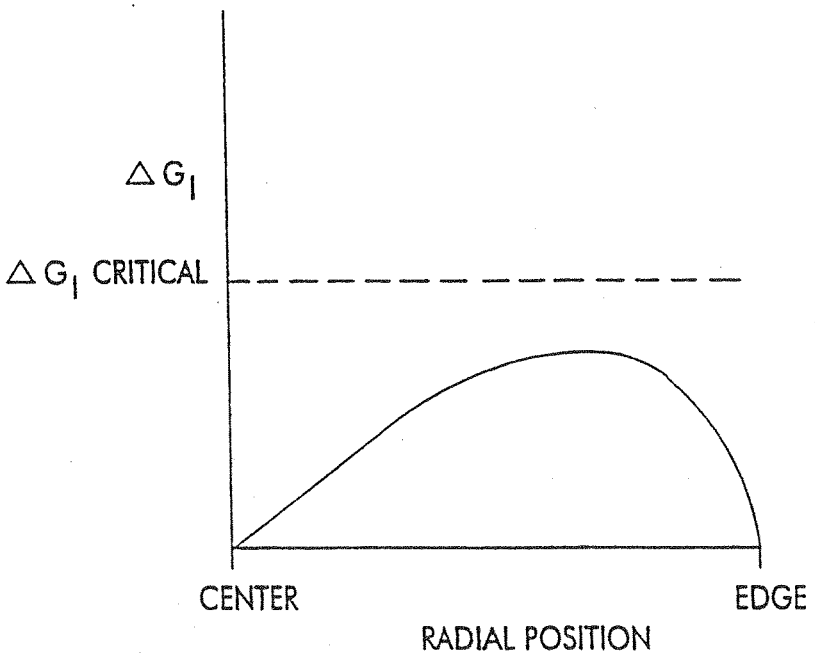

ΔG_I
ΔG_I CRITICAL
CENTER
EDGE
RADIAL POSITION

FIG. 8

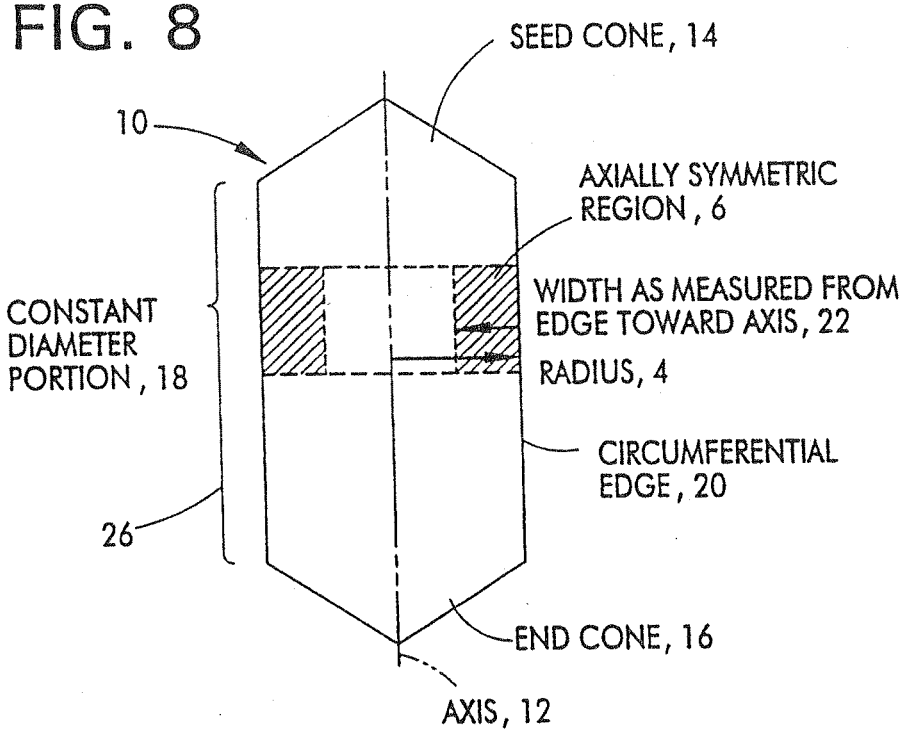

SEED CONE, 14
10
AXIALLY SYMMETRIC REGION, 6
WIDTH AS MEASURED FROM EDGE TOWARD AXIS, 22
CONSTANT DIAMETER PORTION, 18
RADIUS, 4
CIRCUMFERENTIAL EDGE, 20
26
END CONE, 16
AXIS, 12

FIG. 9

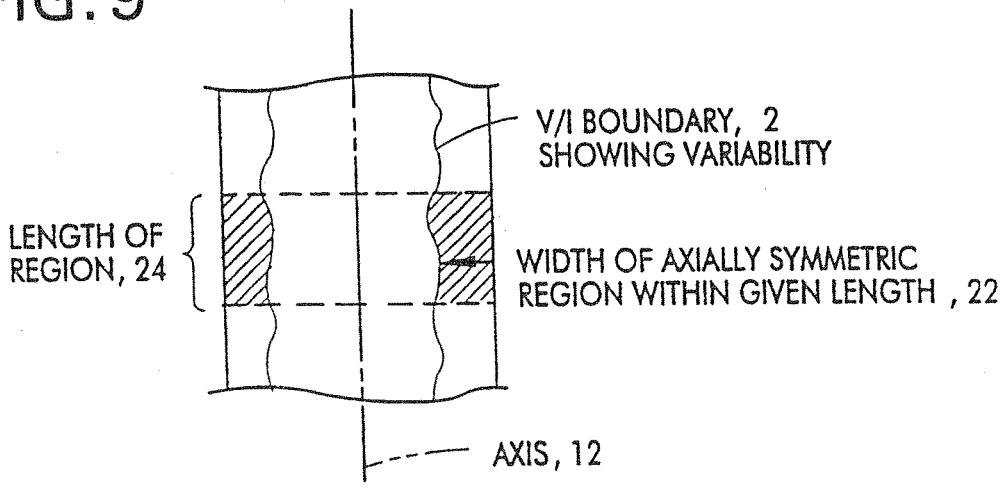

V/I BOUNDARY, 2 SHOWING VARIABILITY
LENGTH OF REGION, 24
WIDTH OF AXIALLY SYMMETRIC REGION WITHIN GIVEN LENGTH, 22
AXIS, 12

FIG. 10

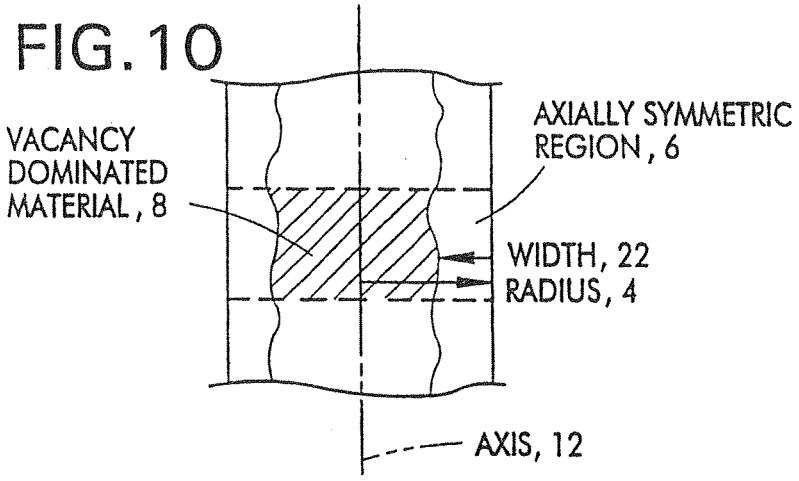


FIG. 11

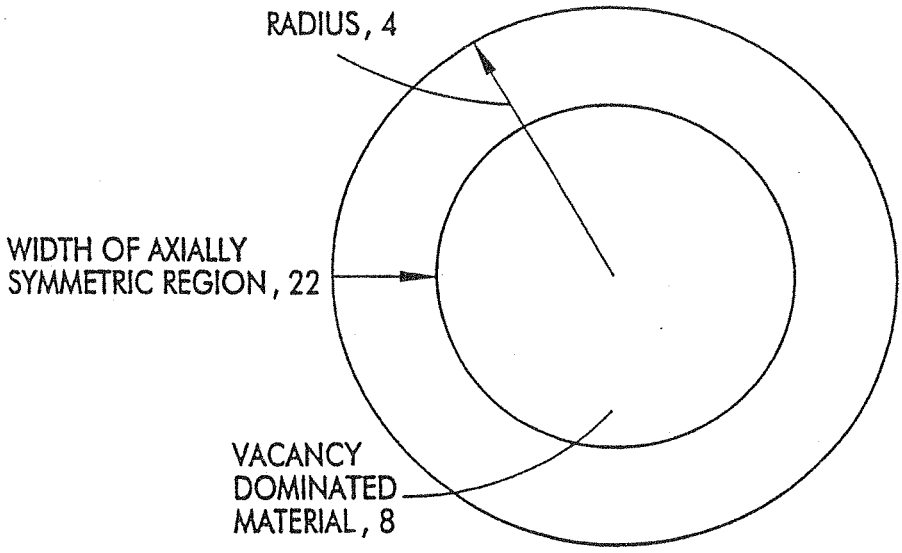
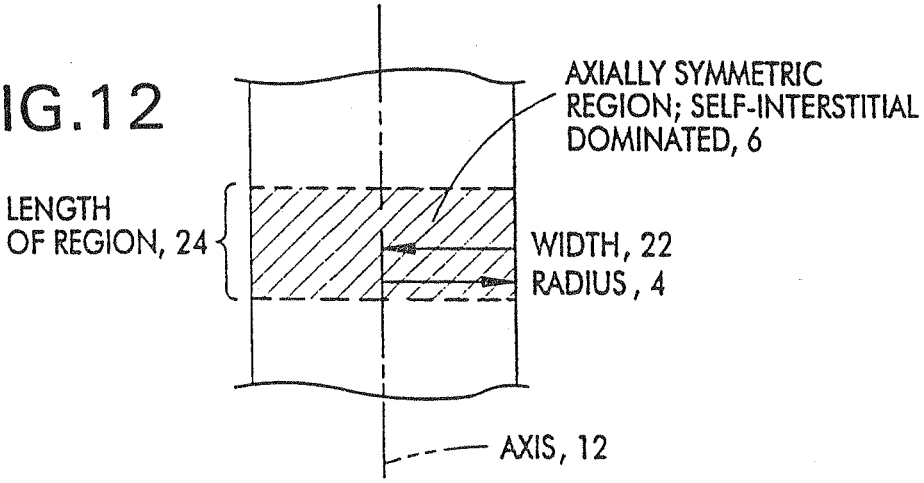


FIG. 12



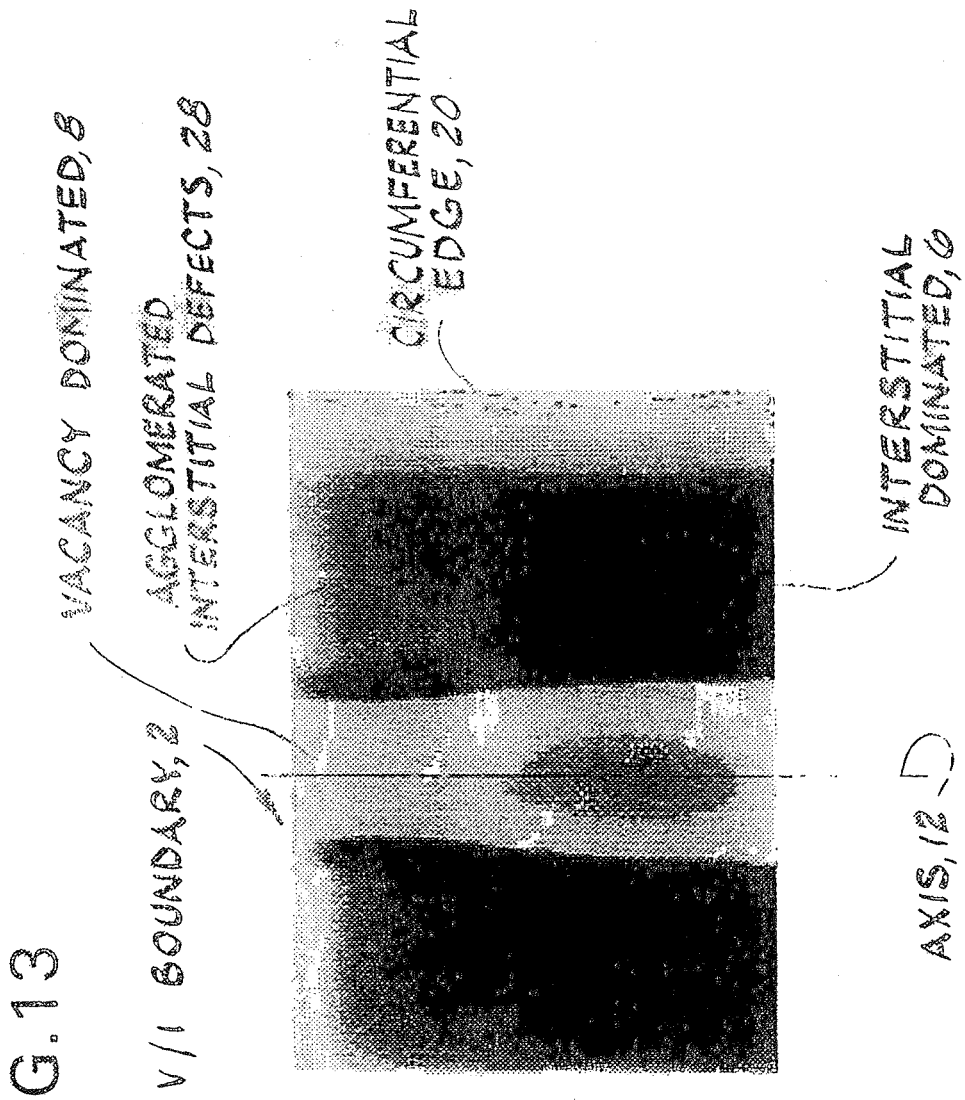

VACANCY DOMINATED, 6
AGGLOMERATED INTERSTITIAL DEFECTS, 28
CIRCUMFERENTIAL EDGE, 20
INTERSTITIAL DOMINATED, 6
V/I BOUNDARY, 2
AXIS, 12

FIG. 13

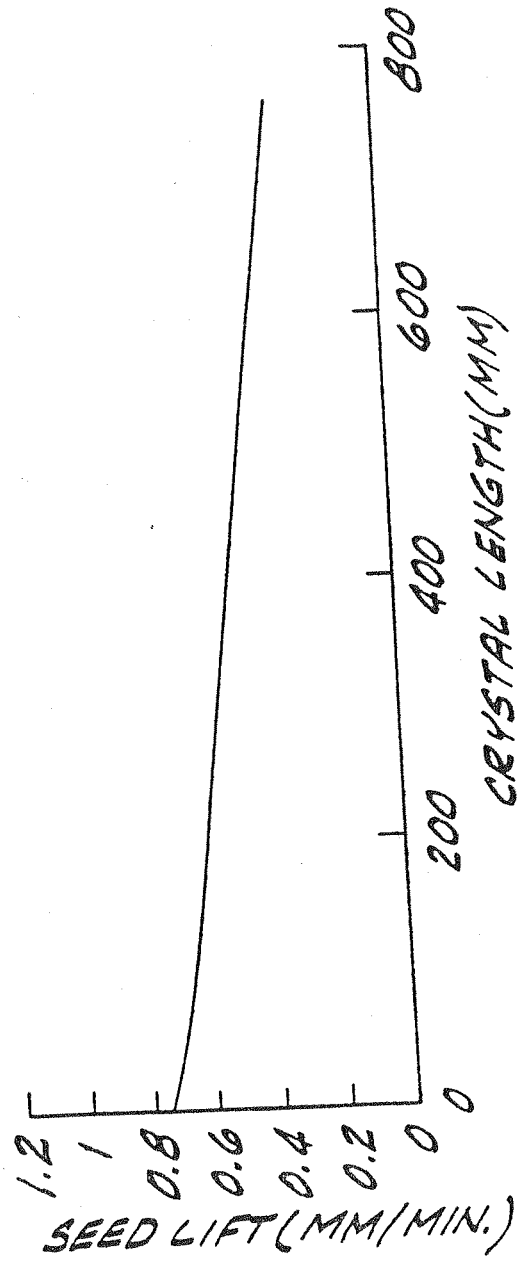

800
600
400
200
0
CRYSTAL LENGTH (MM)
1.2
1
0.8
0.6
0.4
0.2
0
SEED LIFT (MM/MIN.)

FIG.14

FIG. 15


AXIAL POSITION
635 mm
680 mm
760 mm
VACANCY DOMINATED, 8
V/I BOUNDARY, 2
PULL RATE
INTERSTITIAL DOMINATED, 6
0.33 mm/min.
AGGLOMERATED INTERSTITIAL DEFECTS, 28

FIG.16

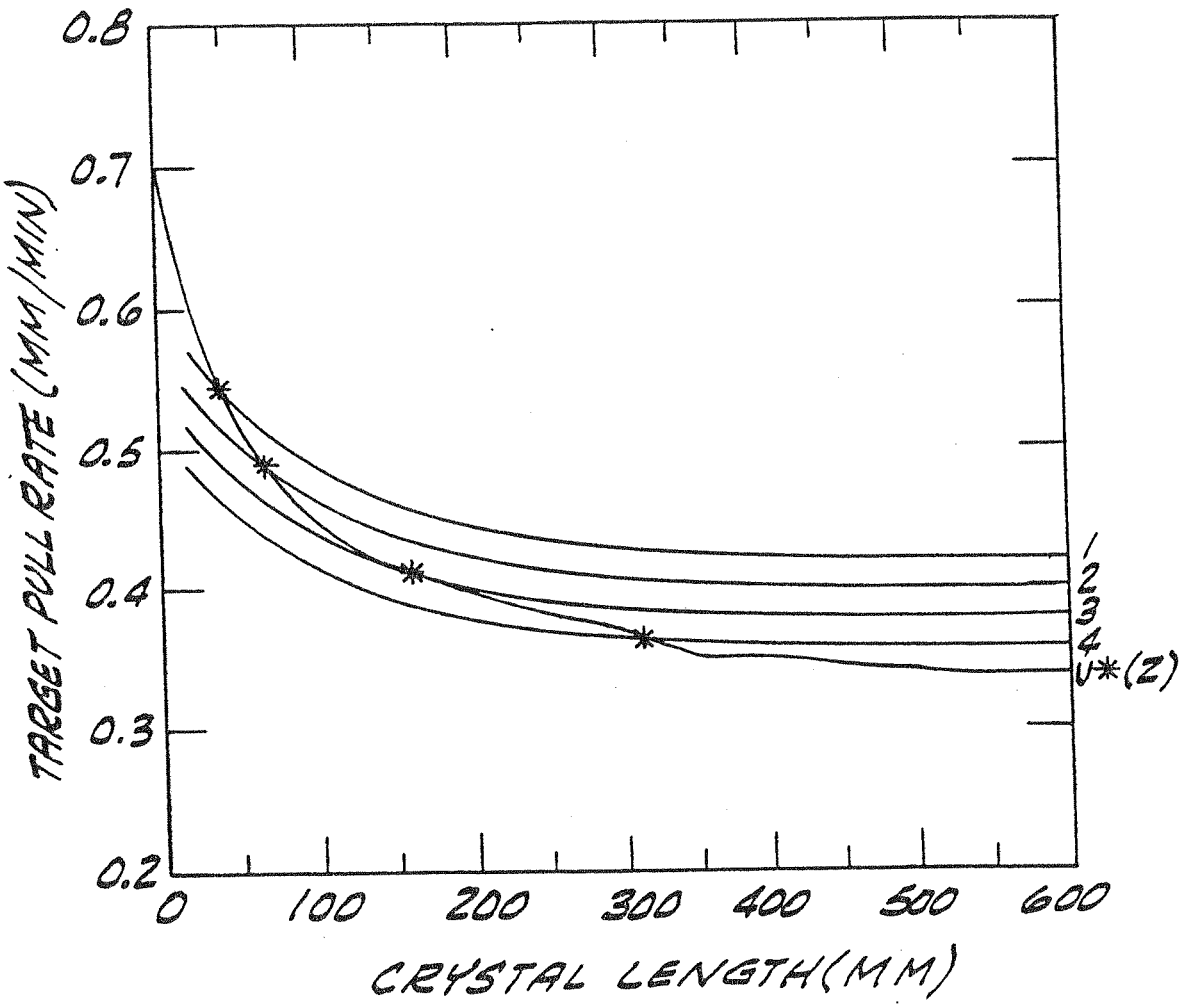

0.8
0.7
0.6
0.5
0.4
0.3
0.2
TARGET PULL RATE (MM/MIN)
0
100
200
300
400
500
600
CRYSTAL LENGTH(MM)
1
2
3
4
V*(Z)

FIG. 17

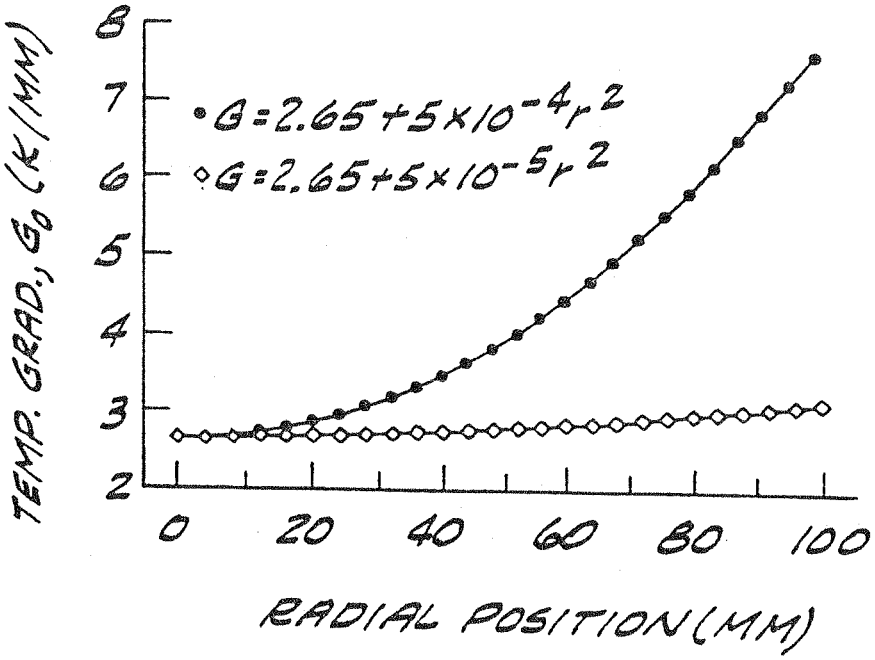

TEMP. GRAD., G_0 (K/MM)
8
7
6
5
4
3
2
$G=2.65+5\times10^{-4}r^2$
$G=2.65+5\times10^{-5}r^2$
0
20
40
60
80
100
RADIAL POSITION (MM)

FIG. 18

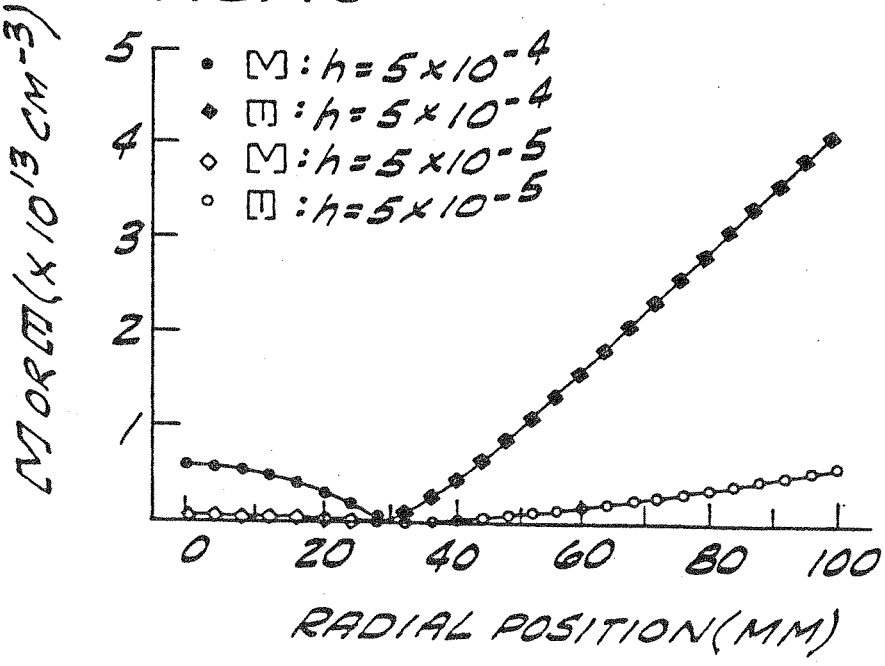

[V] OR [I] ($\times10^{13}$ CM^{-3})
5
4
3
2
1
[V]: $h=5\times10^{-4}$
[I]: $h=5\times10^{-4}$
[V]: $h=5\times10^{-5}$
[I]: $h=5\times10^{-5}$
0
20
40
60
80
100
RADIAL POSITION (MM)

FIG.19

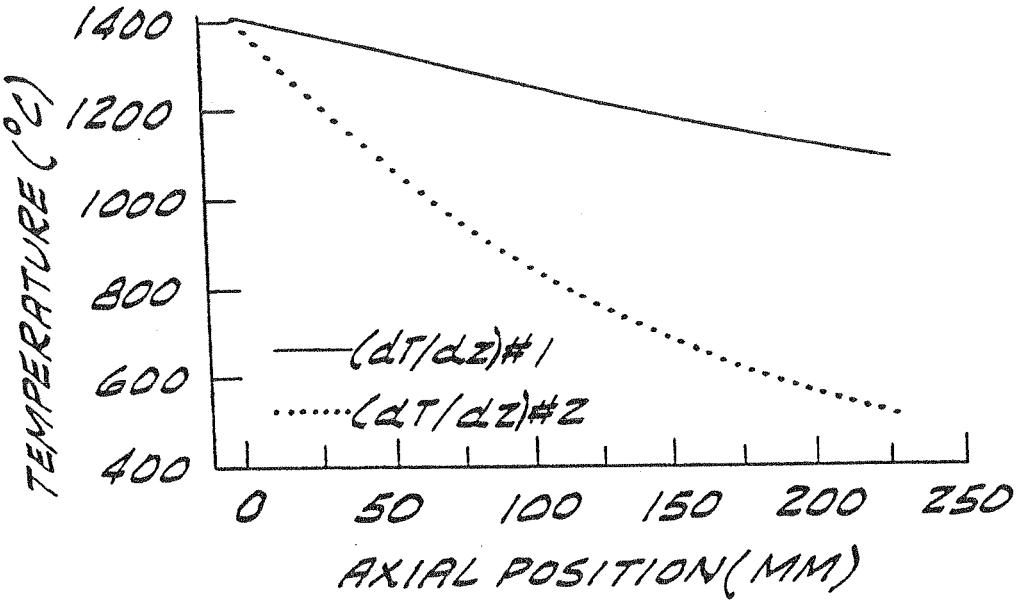

1400
1200
1000
800
600
400
TEMPERATURE (°C)
(dT/dz)#1
(dT/dz)#2
0
50
100
150
200
250
AXIAL POSITION (MM)

FIG.20

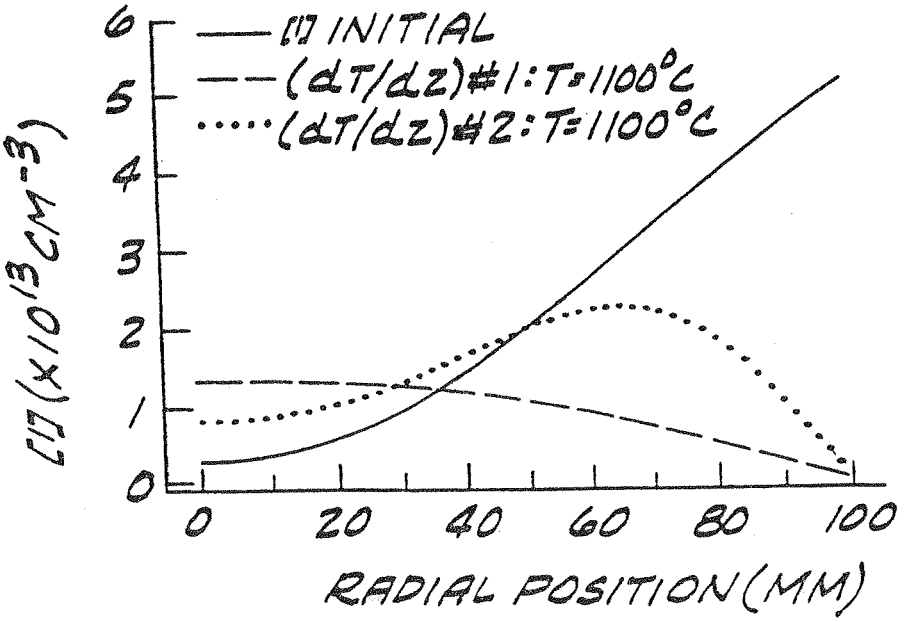
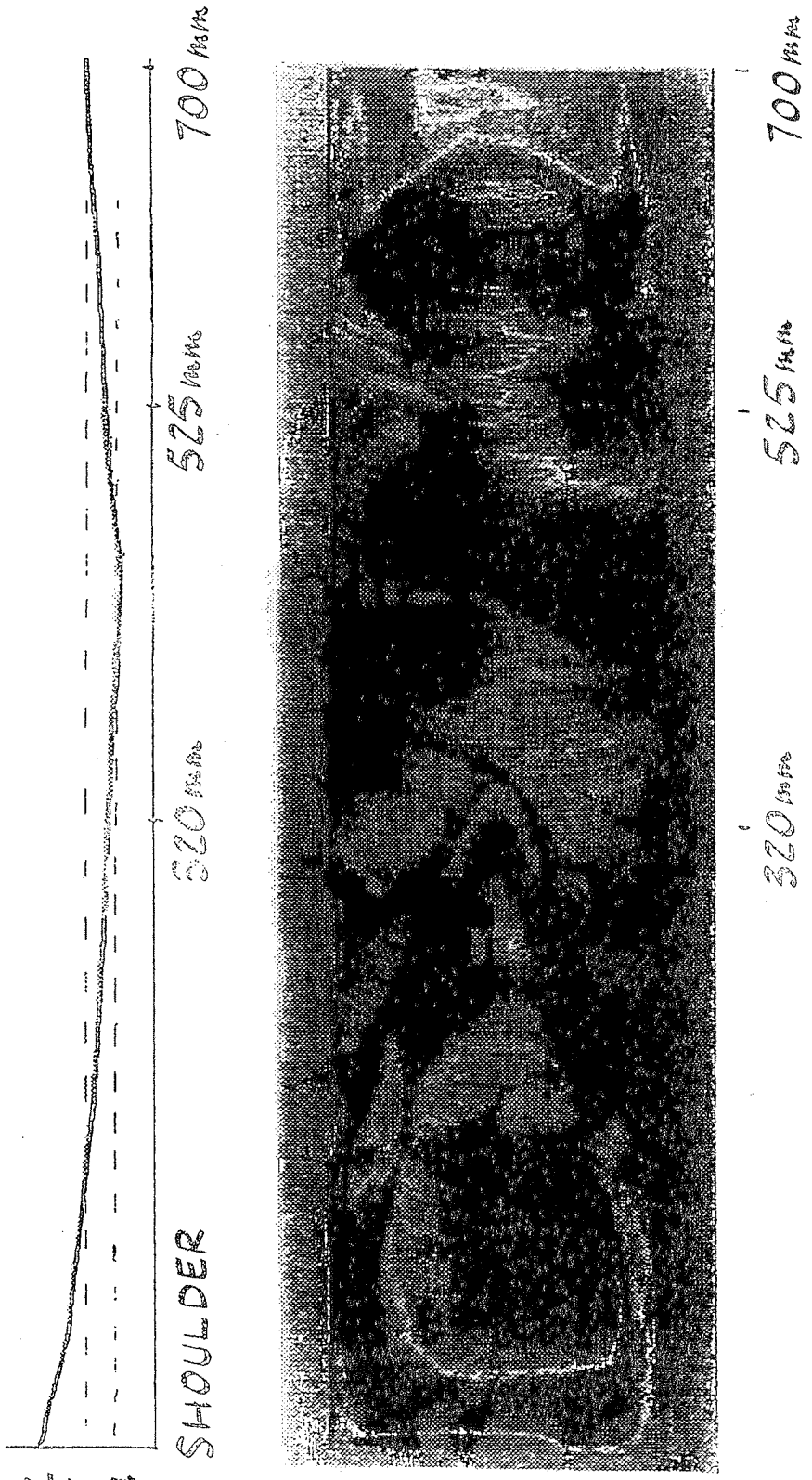

6
5
4
3
2
1
0
[I] (X10^13 CM^-3)
[I] INITIAL
(dT/dz)#1: T=1100°C
(dT/dz)#2: T=1100°C
0
20
40
60
80
100
RADIAL POSITION (MM)

FIG. 21


SEED LIFT (lbs/min.)
1.2
0.7
0.4
SHOULDER
320 lbs
525 lbs
700 lbs
320 lbs
525 lbs
700 lbs