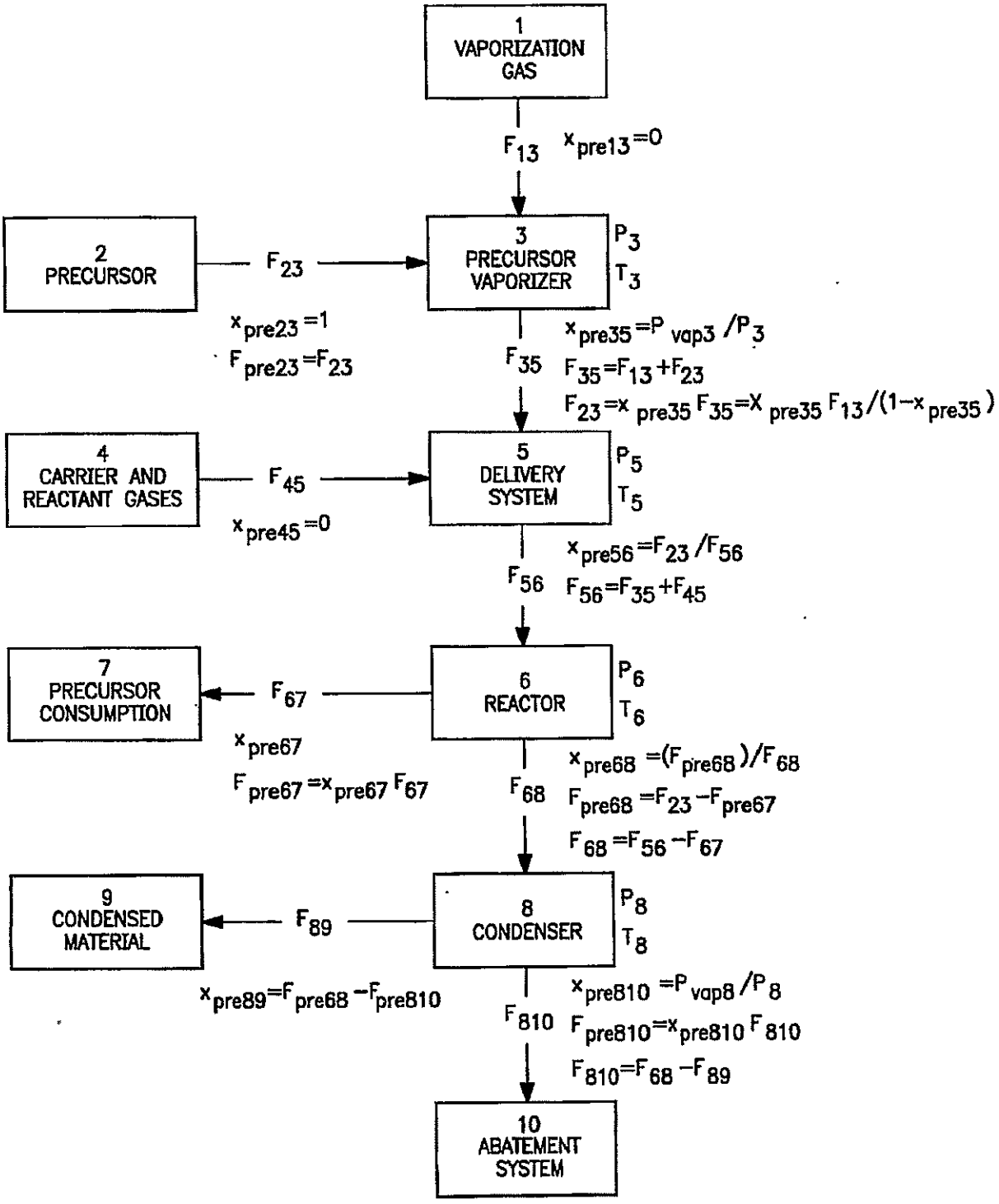
1
VAPORIZATION
GAS
$F_{13}$ $x_{pre13}=0$
2
PRECURSOR
$F_{23}$
3
PRECURSOR
VAPORIZER
$P_3$
$T_3$
$x_{pre23}=1$
$F_{pre23}=F_{23}$
$x_{pre35}=P_{vap3}/P_3$
$F_{35}$ $F_{35}=F_{13}+F_{23}$
$F_{23}=x_{pre35}F_{35}=X_{pre35}F_{13}/(1-x_{pre35})$
4
CARRIER AND
REACTANT GASES
$F_{45}$
5
DELIVERY
SYSTEM
$P_5$
$T_5$
$x_{pre45}=0$
$x_{pre56}=F_{23}/F_{56}$
$F_{56}$ $F_{56}=F_{35}+F_{45}$
7
PRECURSOR
CONSUMPTION
$F_{67}$
6
REACTOR
$P_6$
$T_6$
$x_{pre67}$
$F_{pre67}=x_{pre67}F_{67}$
$x_{pre68}=(F_{pre68})/F_{68}$
$F_{68}$ $F_{pre68}=F_{23}-F_{pre67}$
$F_{68}=F_{56}-F_{67}$
9
CONDENSED
MATERIAL
$F_{89}$
8
CONDENSER
$P_8$
$T_8$
$x_{pre89}=F_{pre68}-F_{pre810}$
$x_{pre810}=P_{vap8}/P_8$
$F_{810}$ $F_{pre810}=x_{pre810}F_{810}$
$F_{810}=F_{68}-F_{89}$
10
ABATEMENT
SYSTEM

FIG. 1

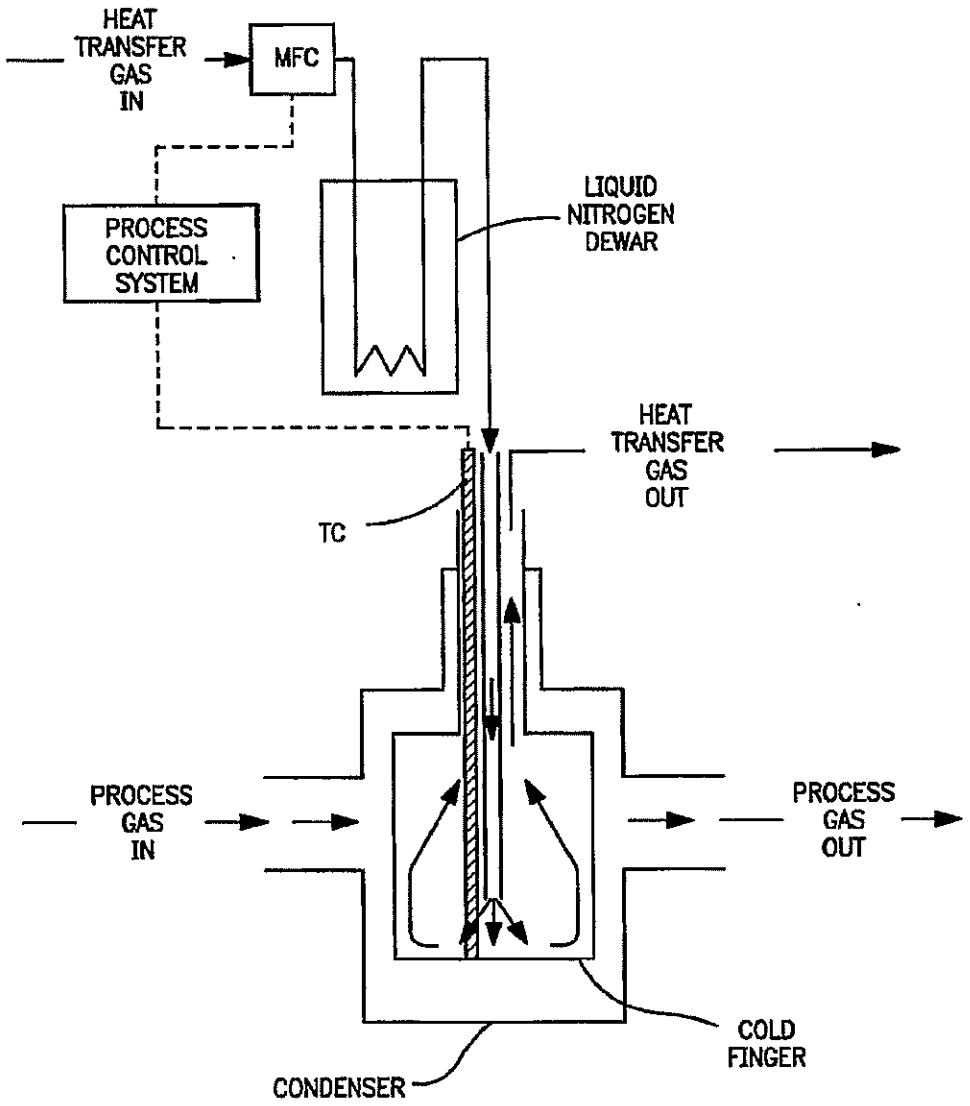
HEAT
TRANSFER
GAS
IN
MFC
PROCESS
CONTROL
SYSTEM
LIQUID
NITROGEN
DEWAR
HEAT
TRANSFER
GAS
OUT
TC
PROCESS
GAS
IN
PROCESS
GAS
OUT
COLD
FINGER
CONDENSER

FIG. 2

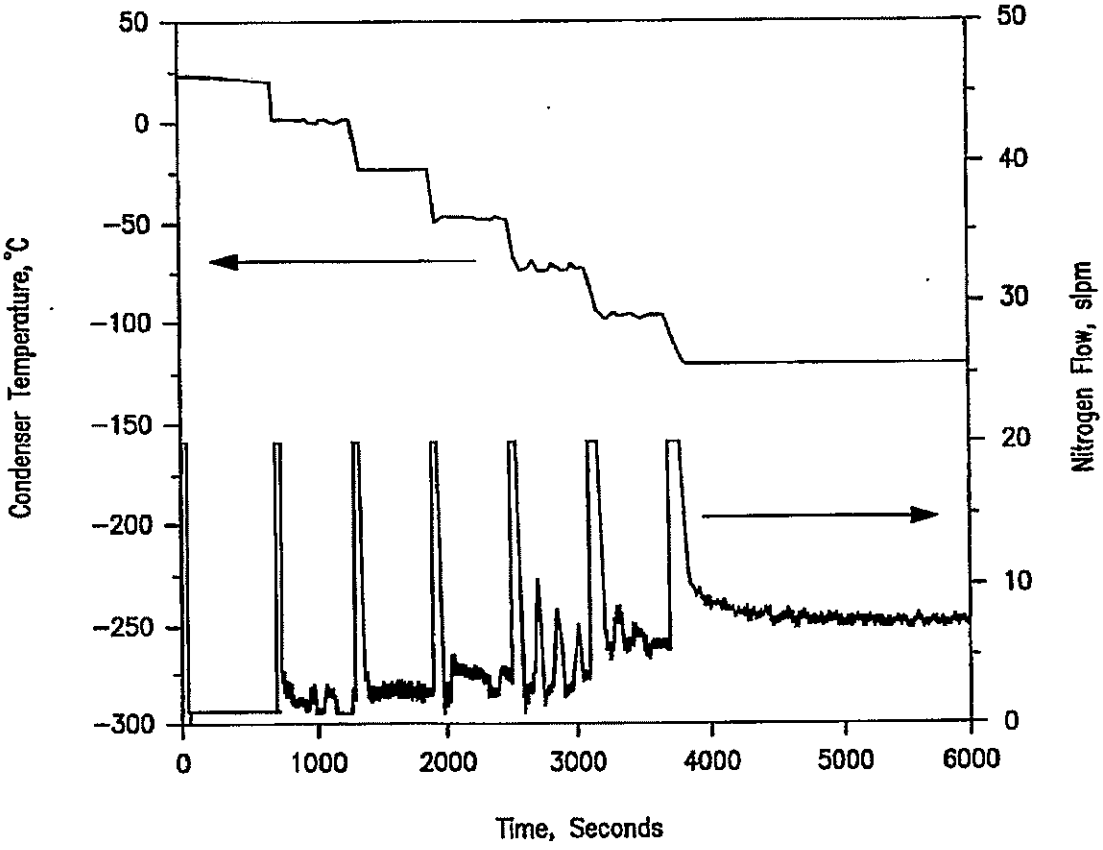
50
0
−50
−100
−150
−200
−250
−300
Condenser Temperature, °C
50
40
30
20
10
0
Nitrogen Flow, slpm
0
1000
2000
3000
4000
5000
6000
Time, Seconds

FIG. 3

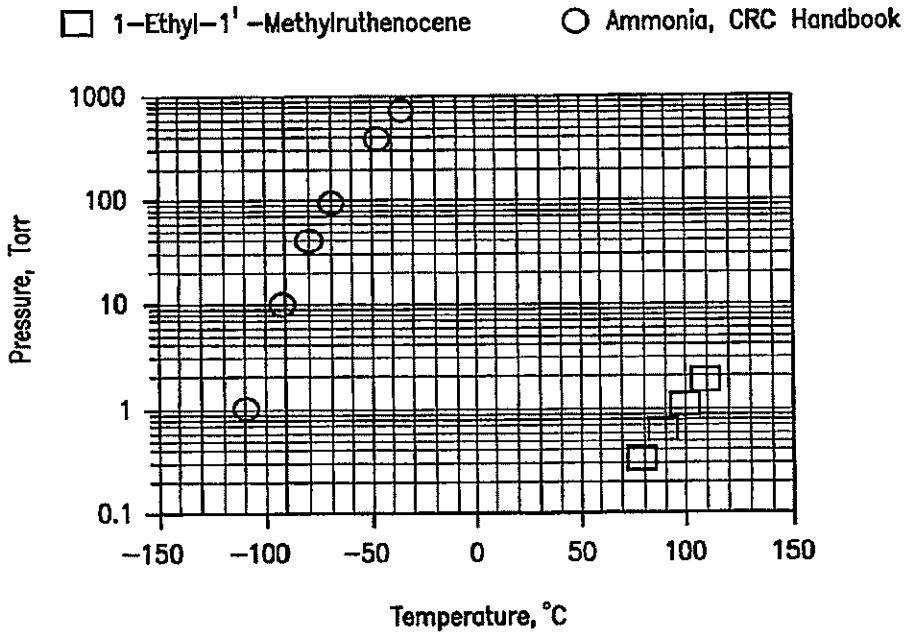
1–Ethyl–1' –Methylruthenocene
Ammonia, CRC Handbook
1000
100
10
1
0.1
Pressure, Torr
–150
–100
–50
0
50
100
150
Temperature, °C

FIG. 4