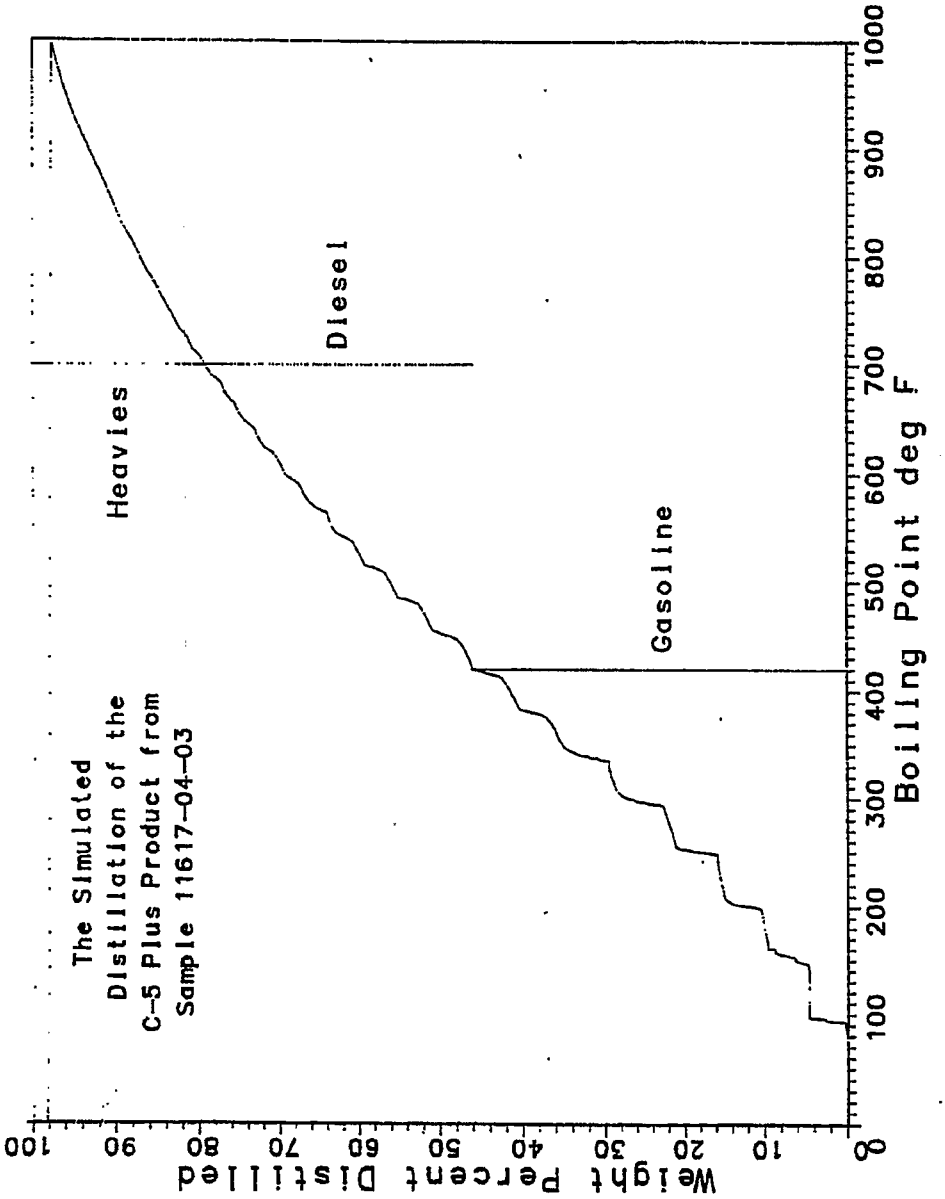

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-03
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B89

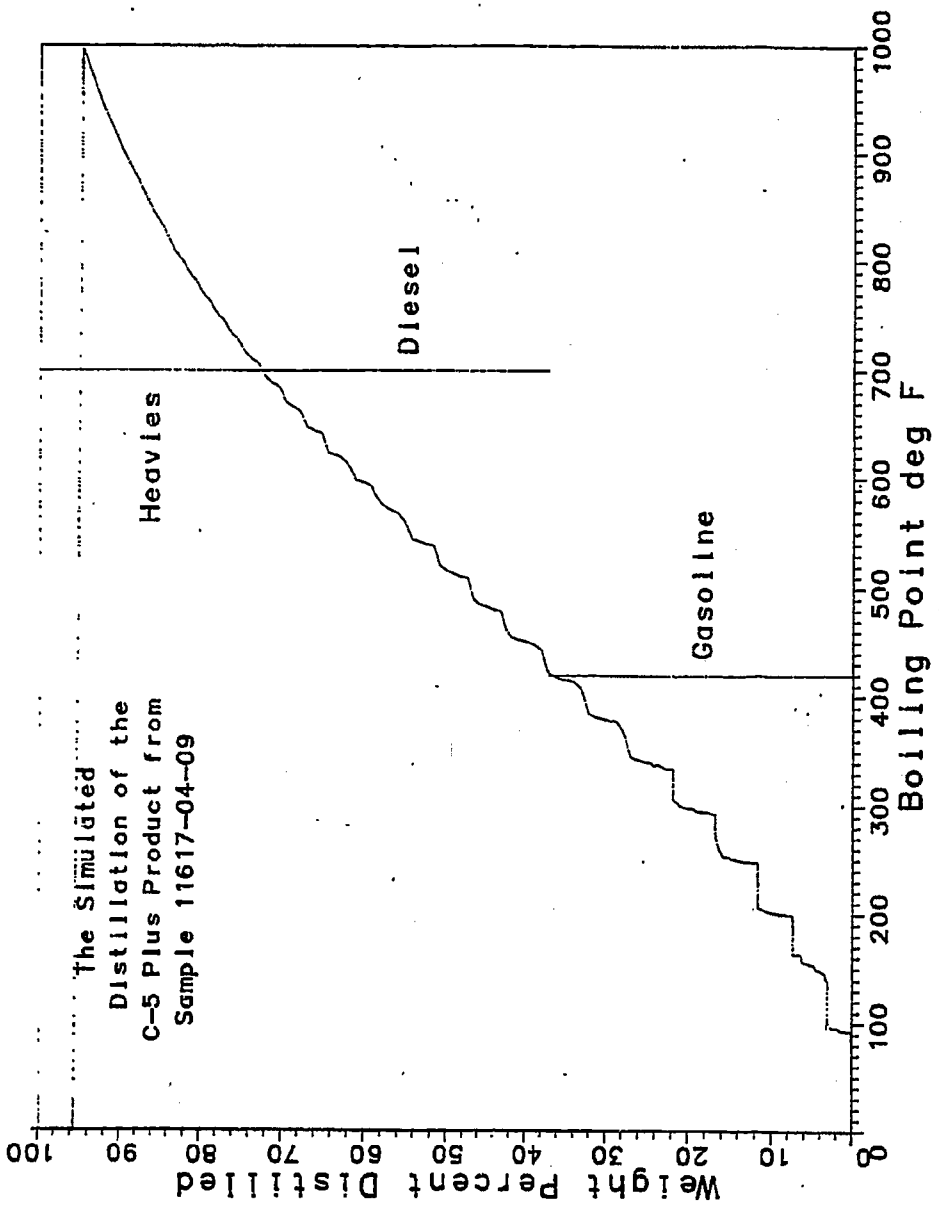

Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-09
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B90

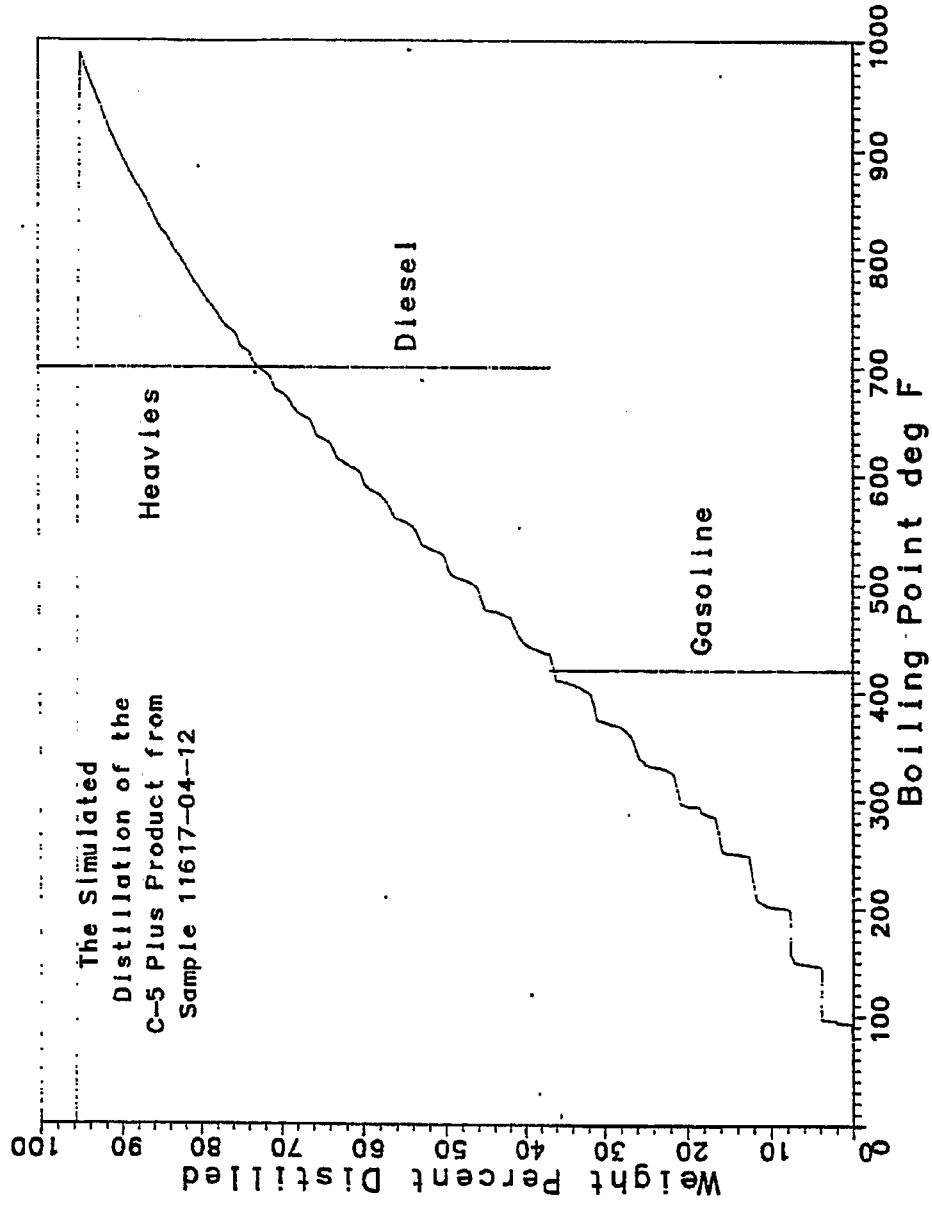

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-12
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B91

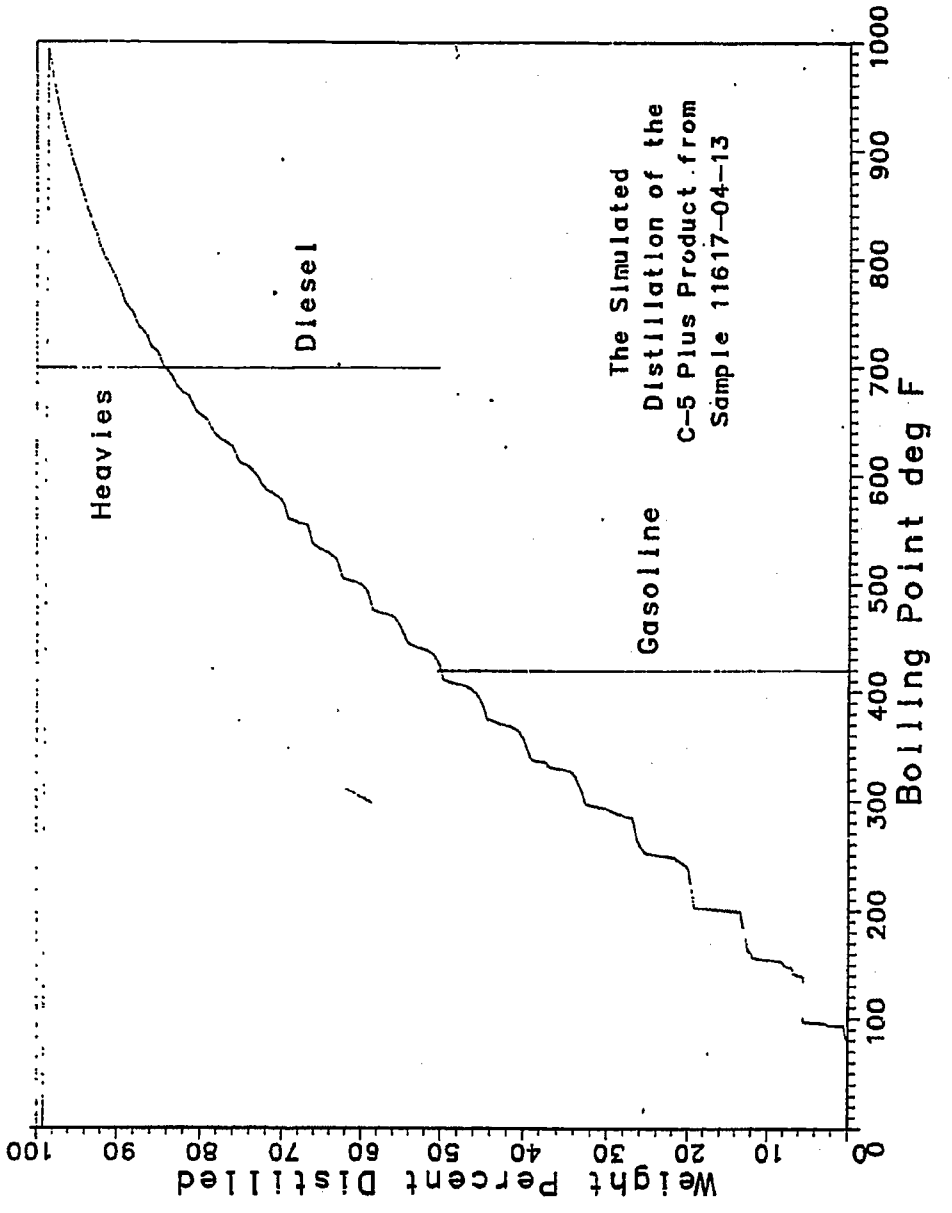

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-13
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B92

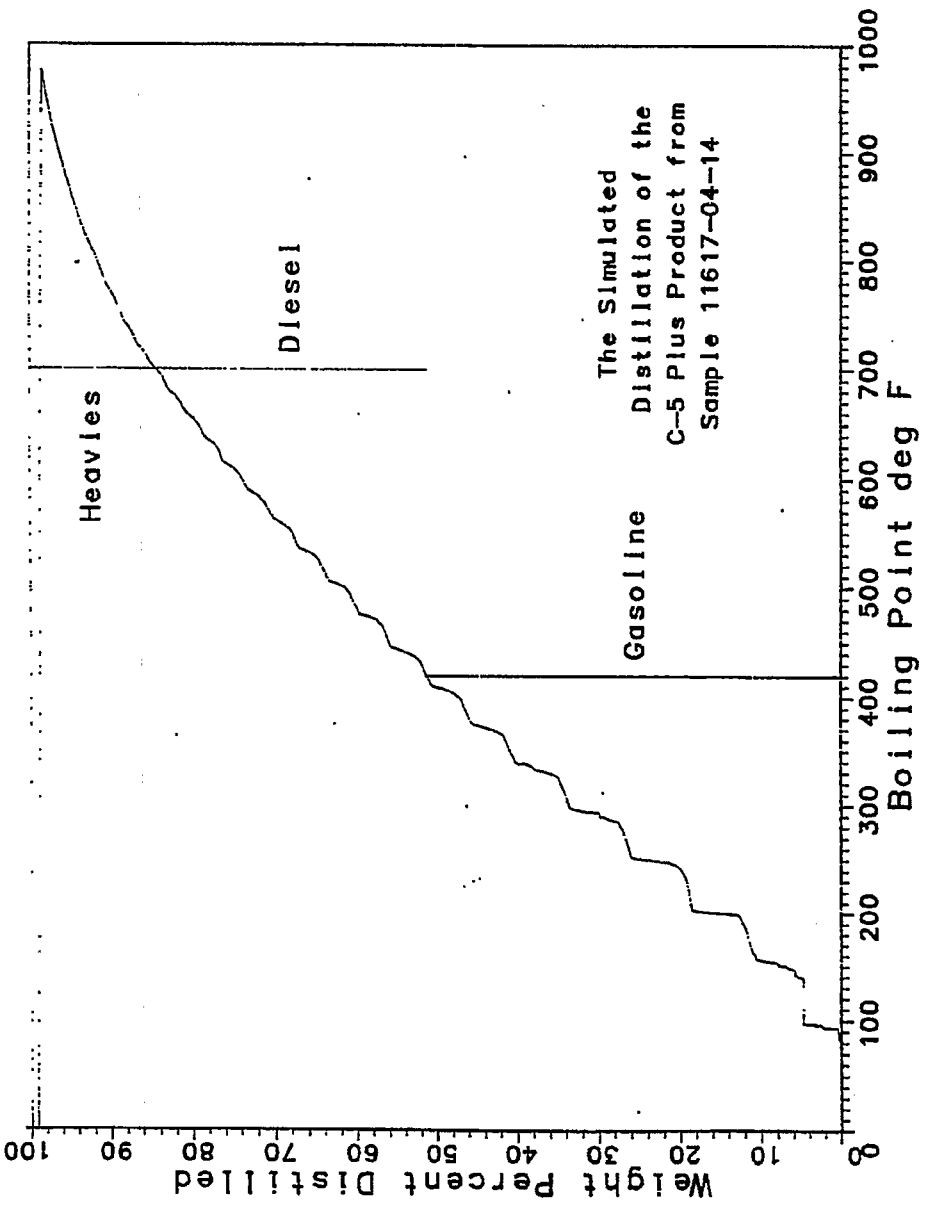

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-14
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B93

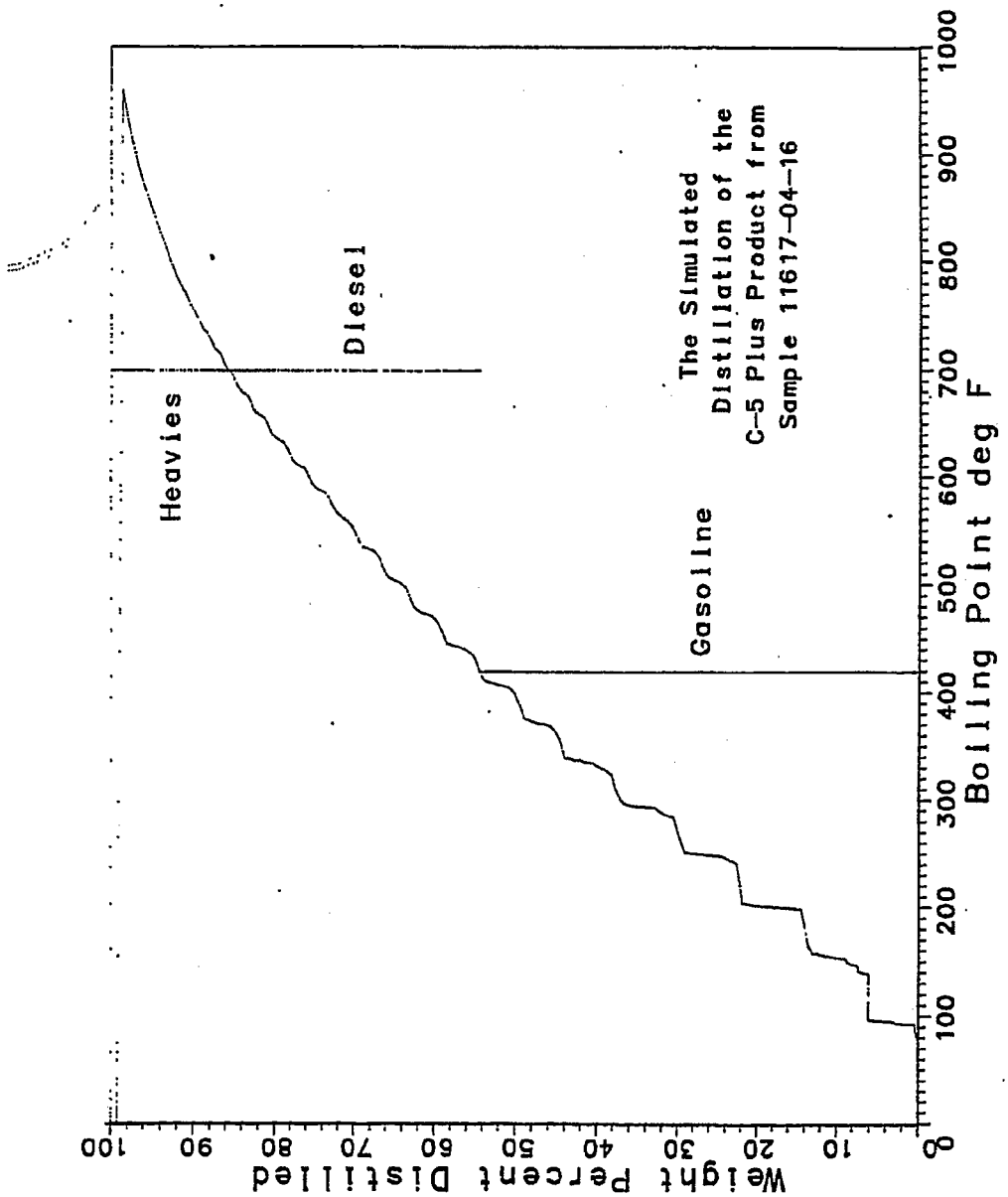

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-16
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B94

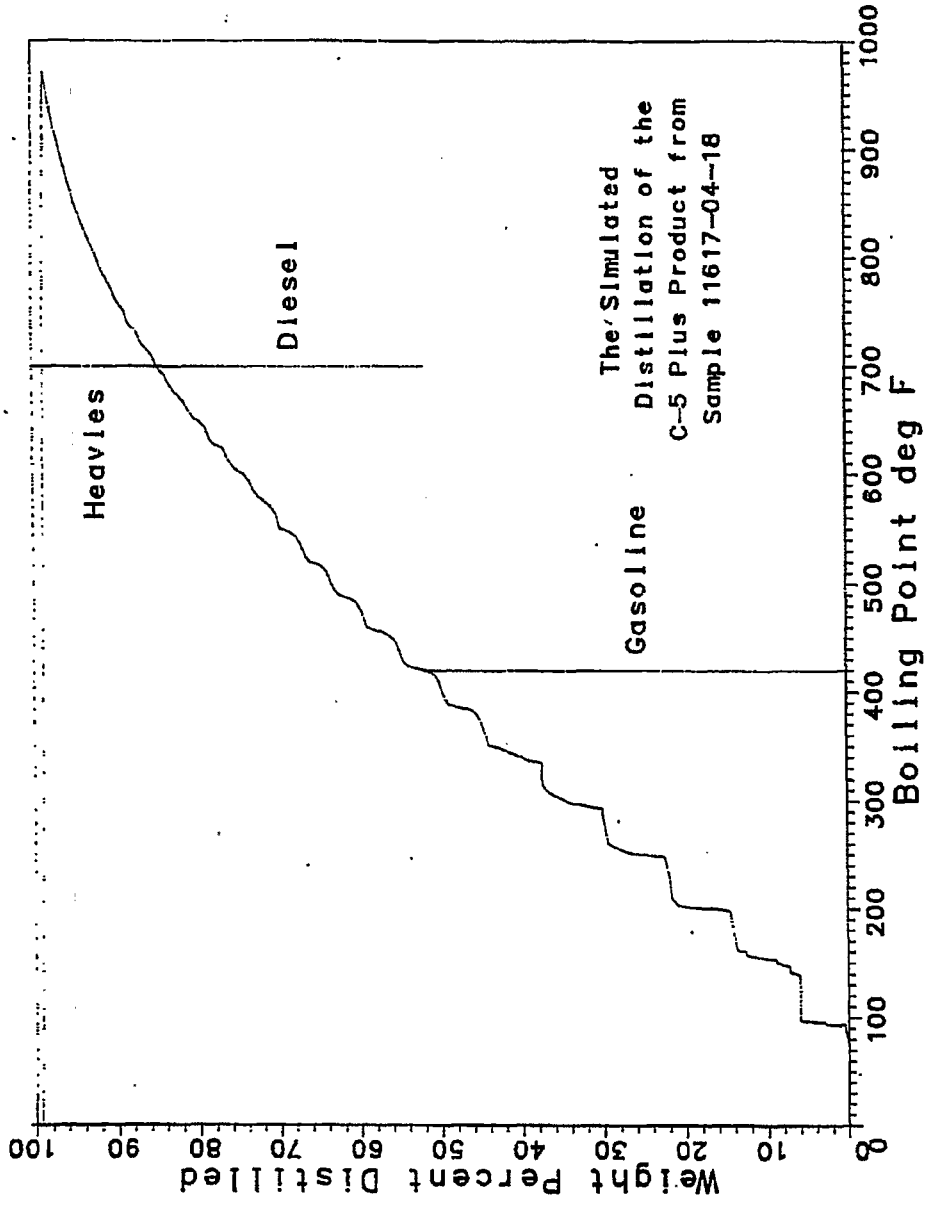

Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point deg F
100
200
300
400
500
600
700
800
900
1000
Heavies
Diesel
Gasoline
The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-18

Fig. B95

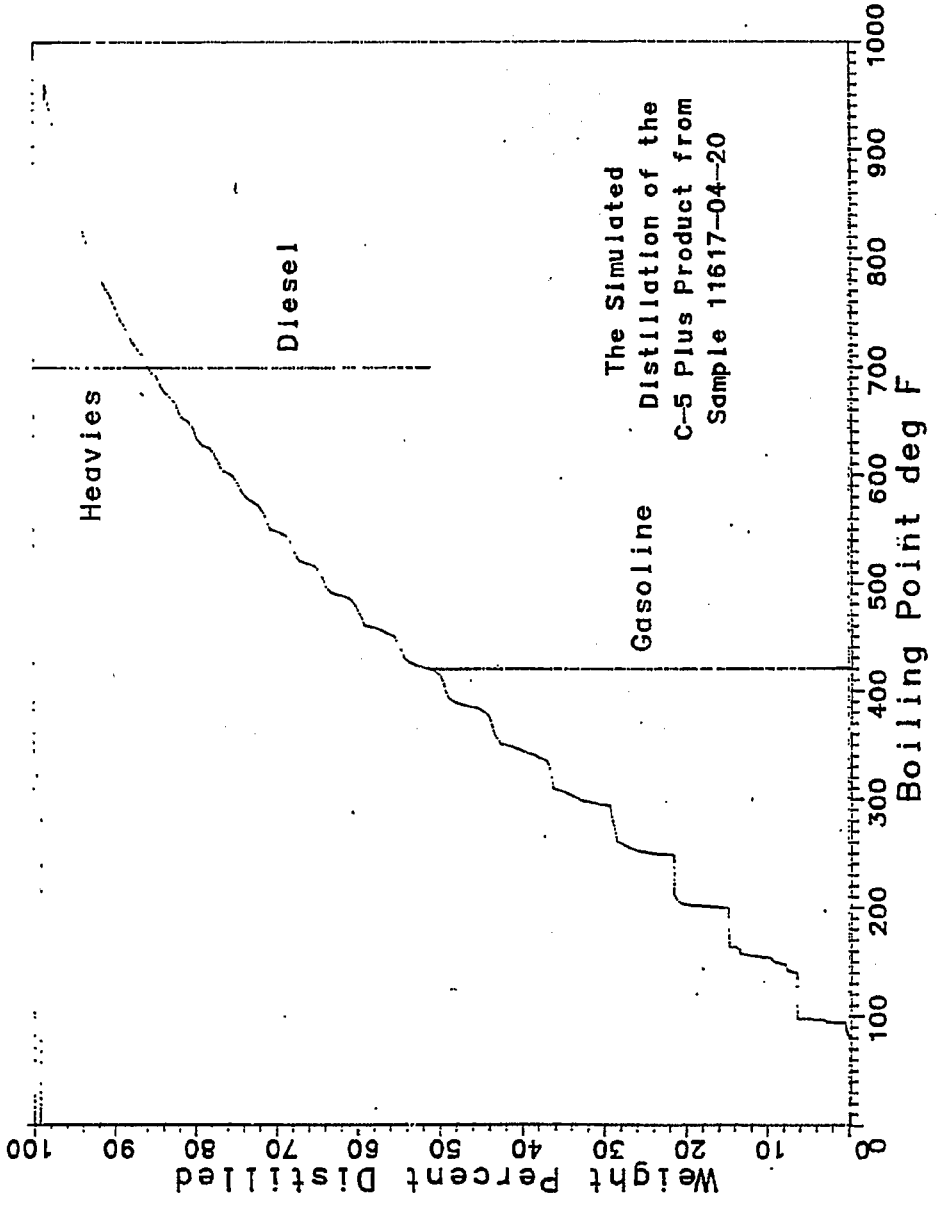

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-04-20
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B96

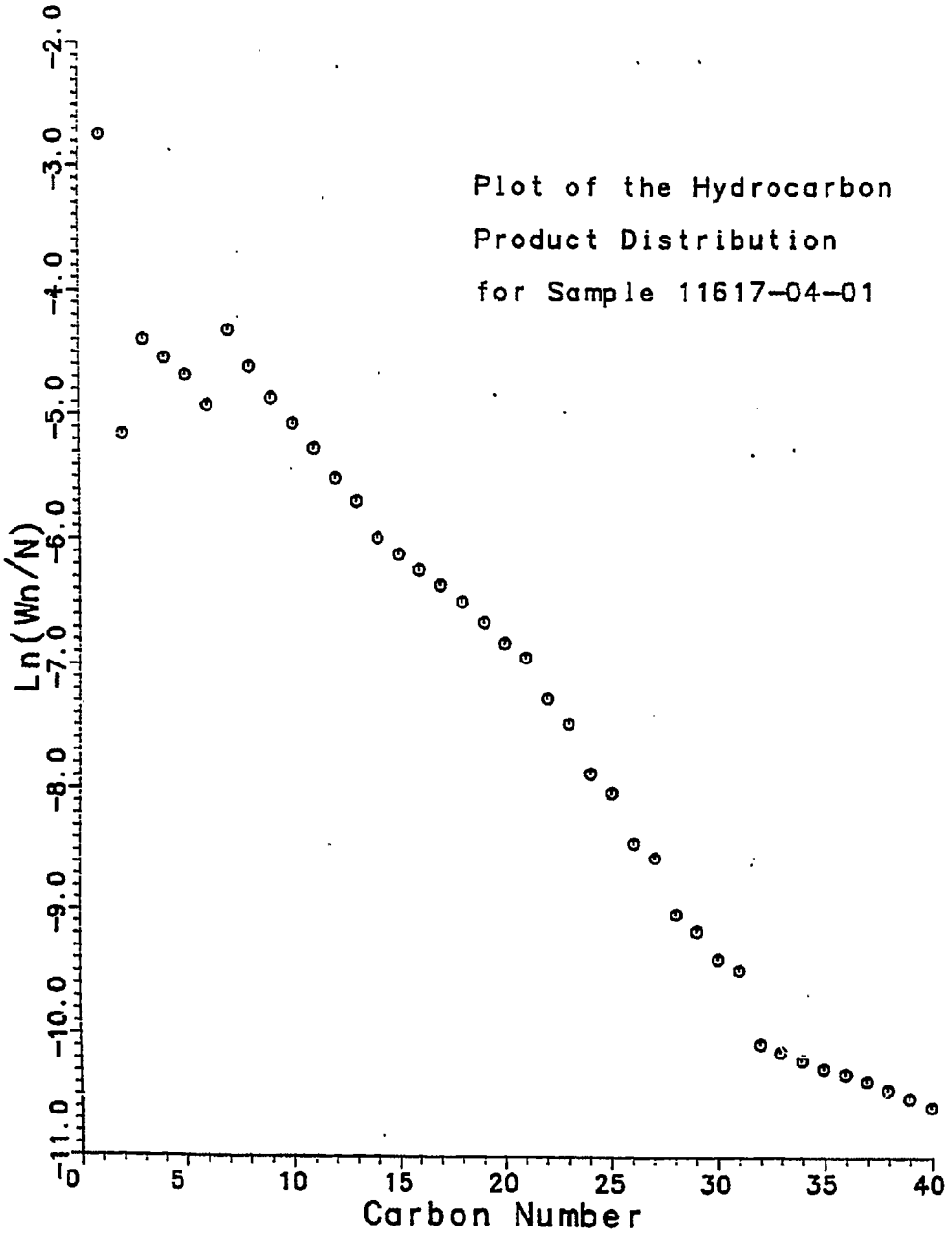

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-01
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B97

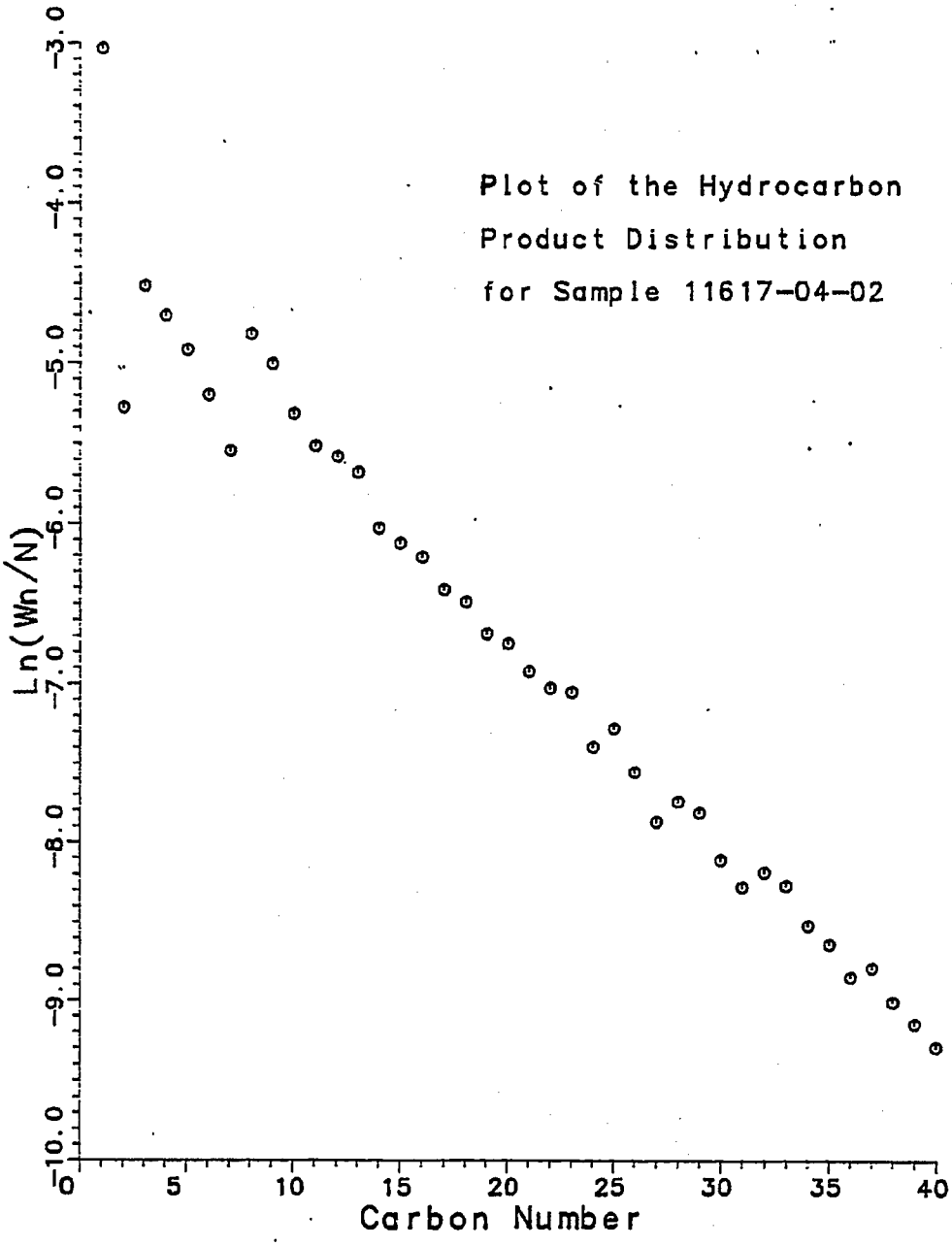

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-02
Ln(Wn/N)
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B98

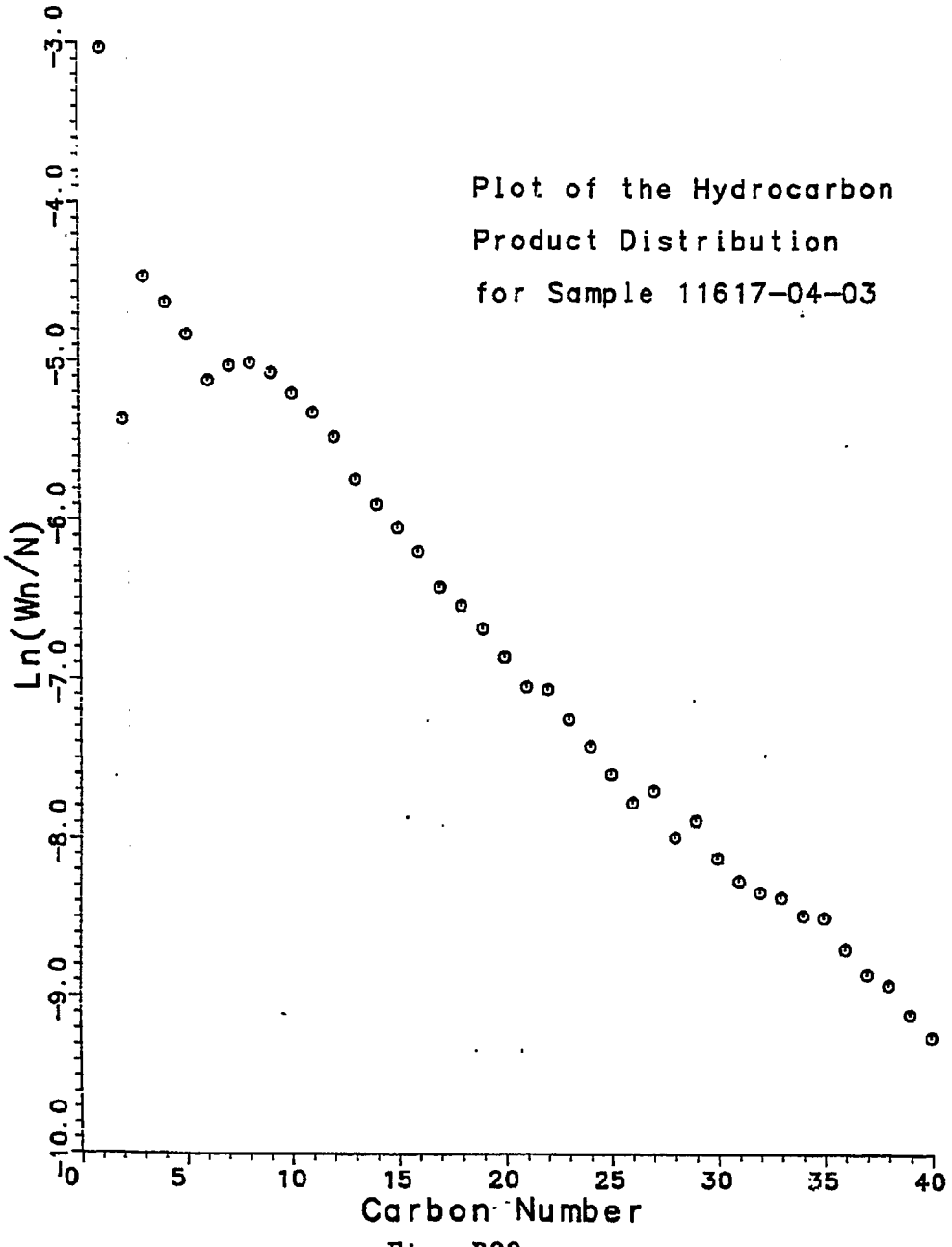

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-03
Ln(Wn/N)
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B99

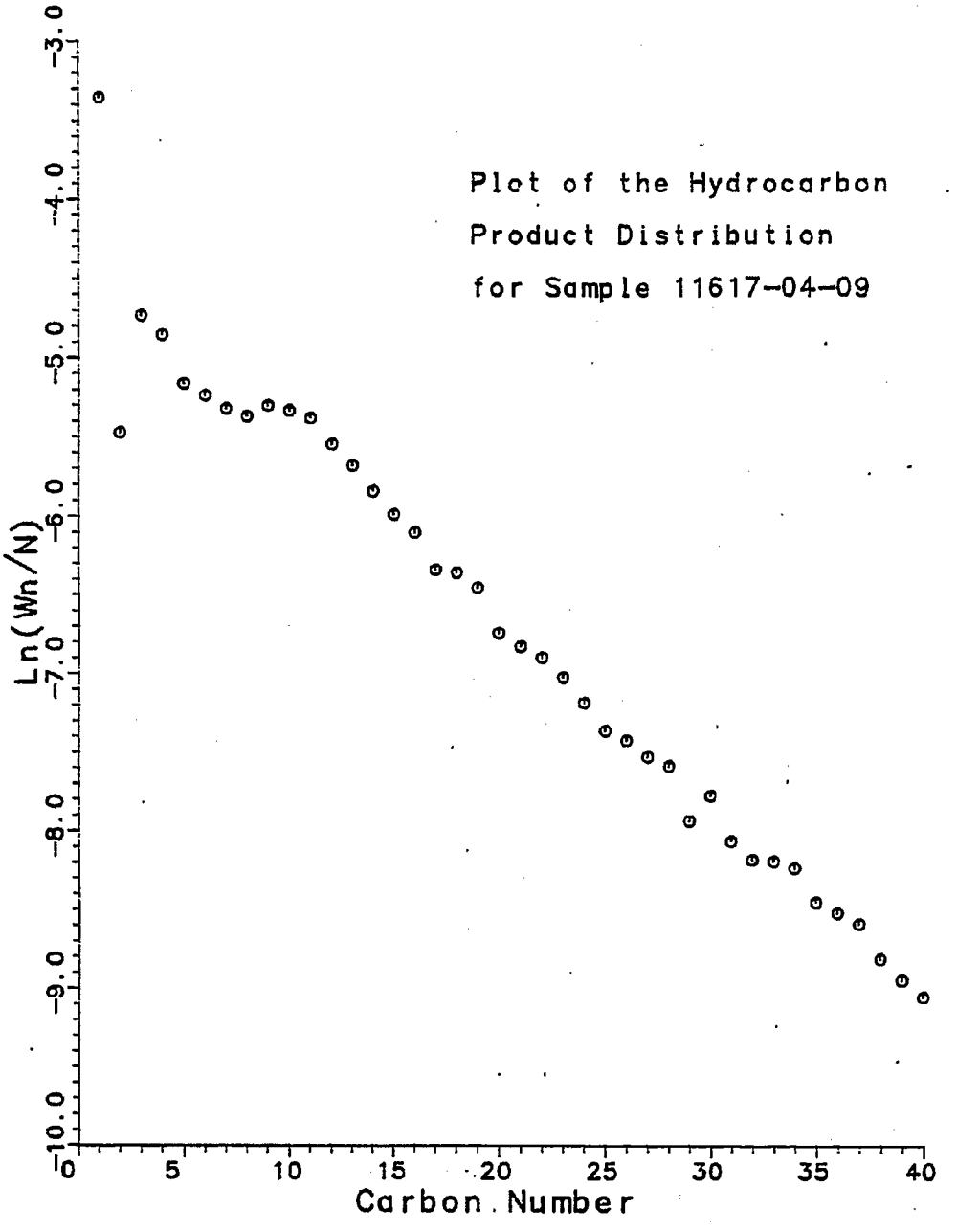

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-09
Ln(Wn/N)
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B100

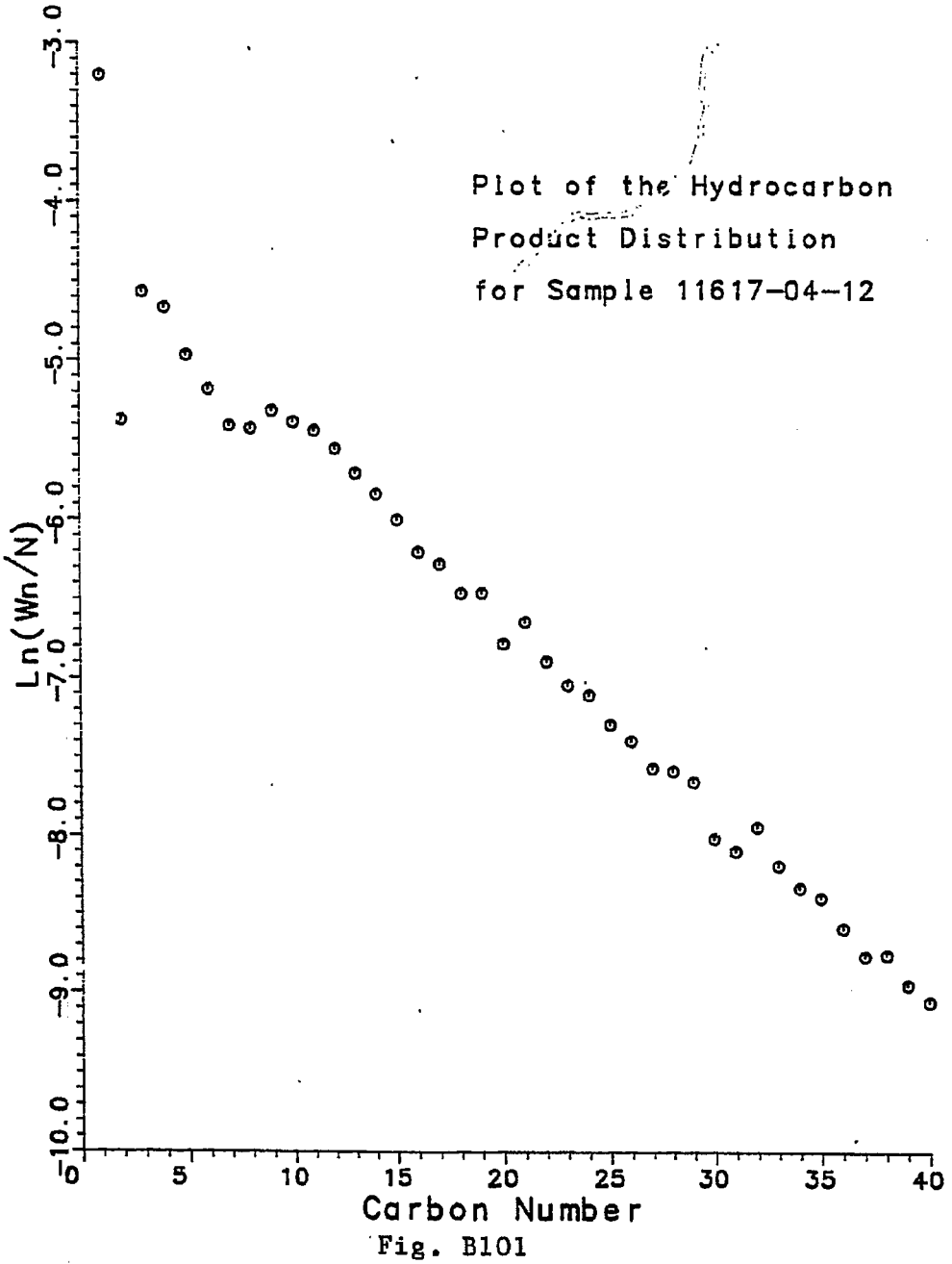

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-12
Ln(Wn/N)
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B101

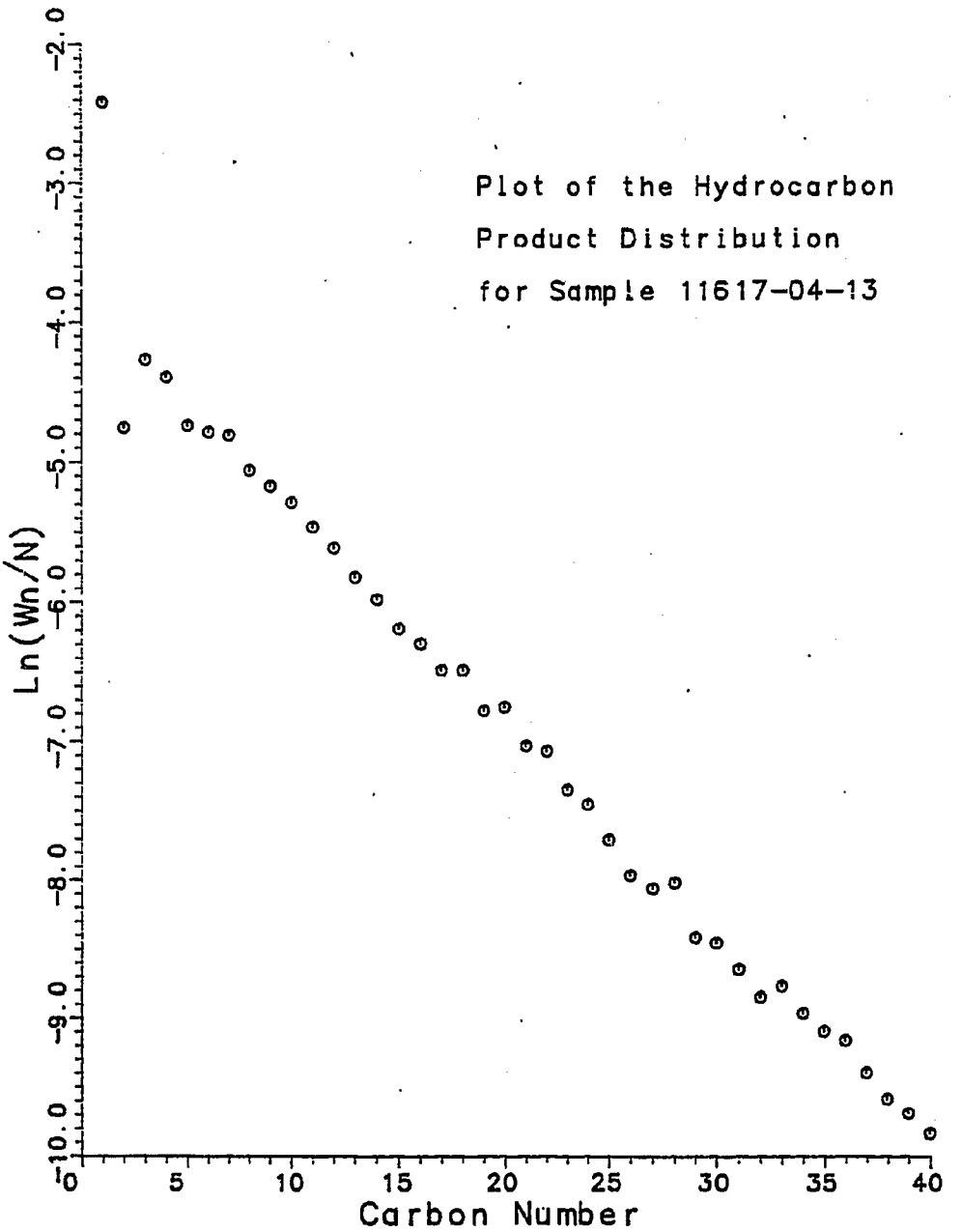

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-13
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B102

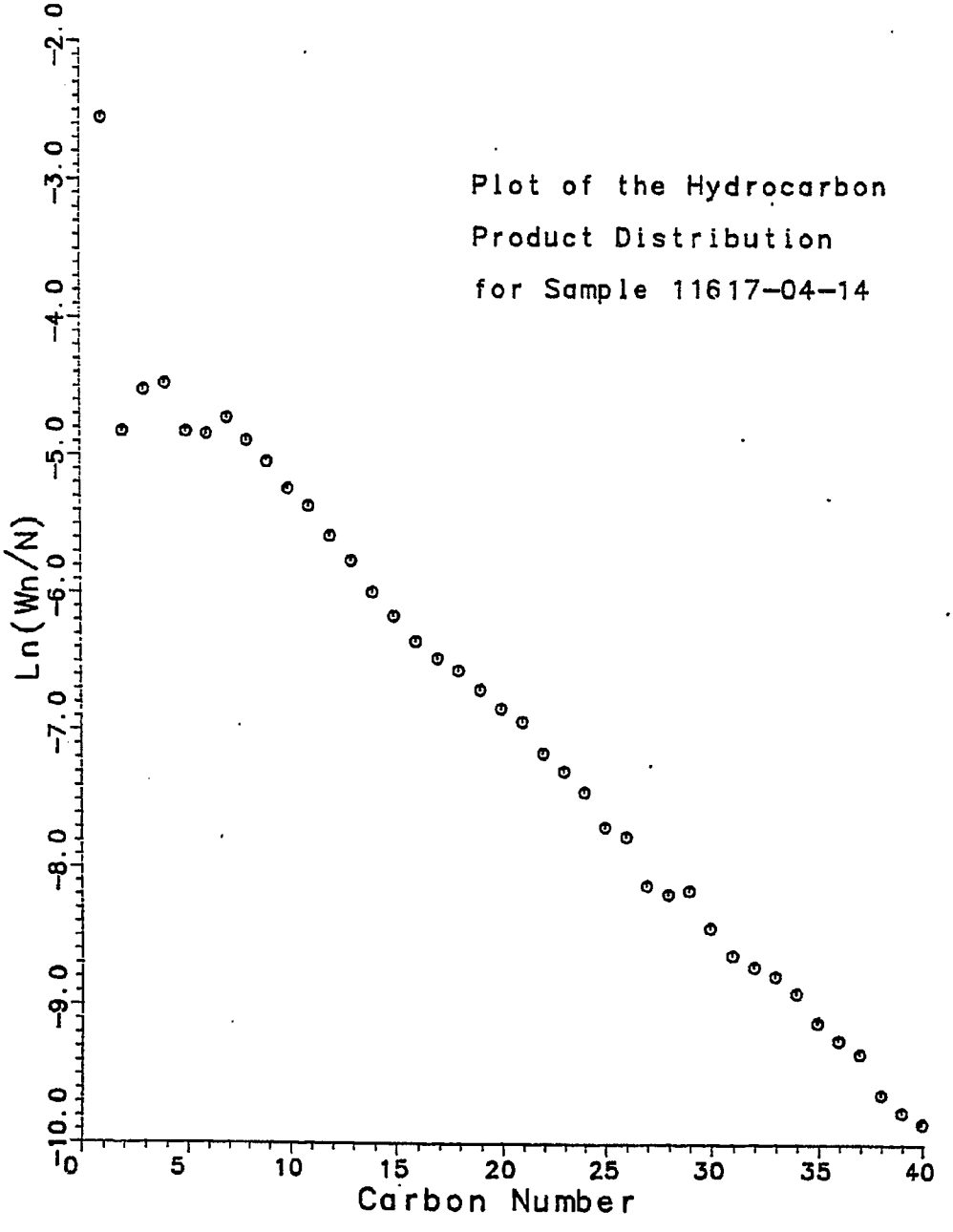

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-14
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B103

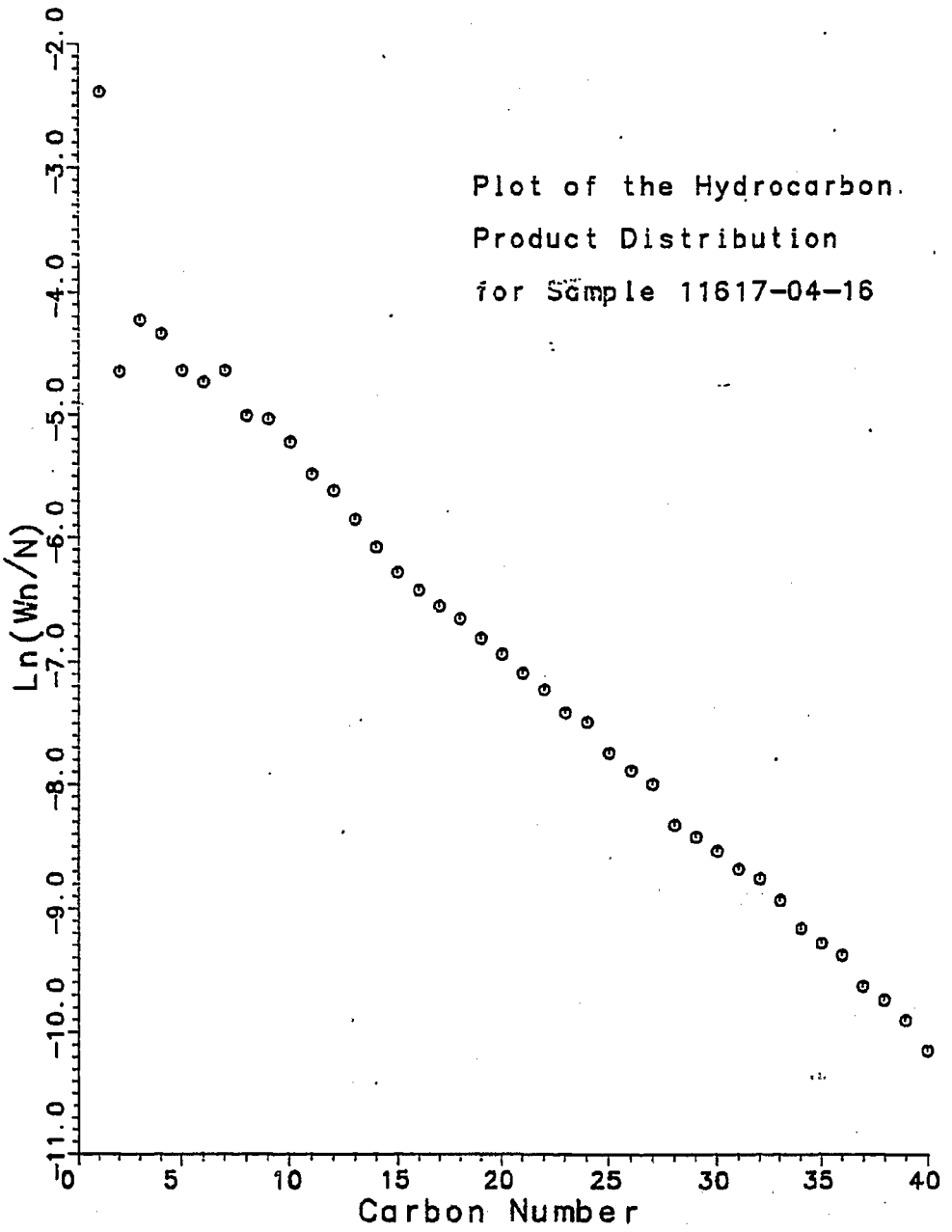

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-16
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B104

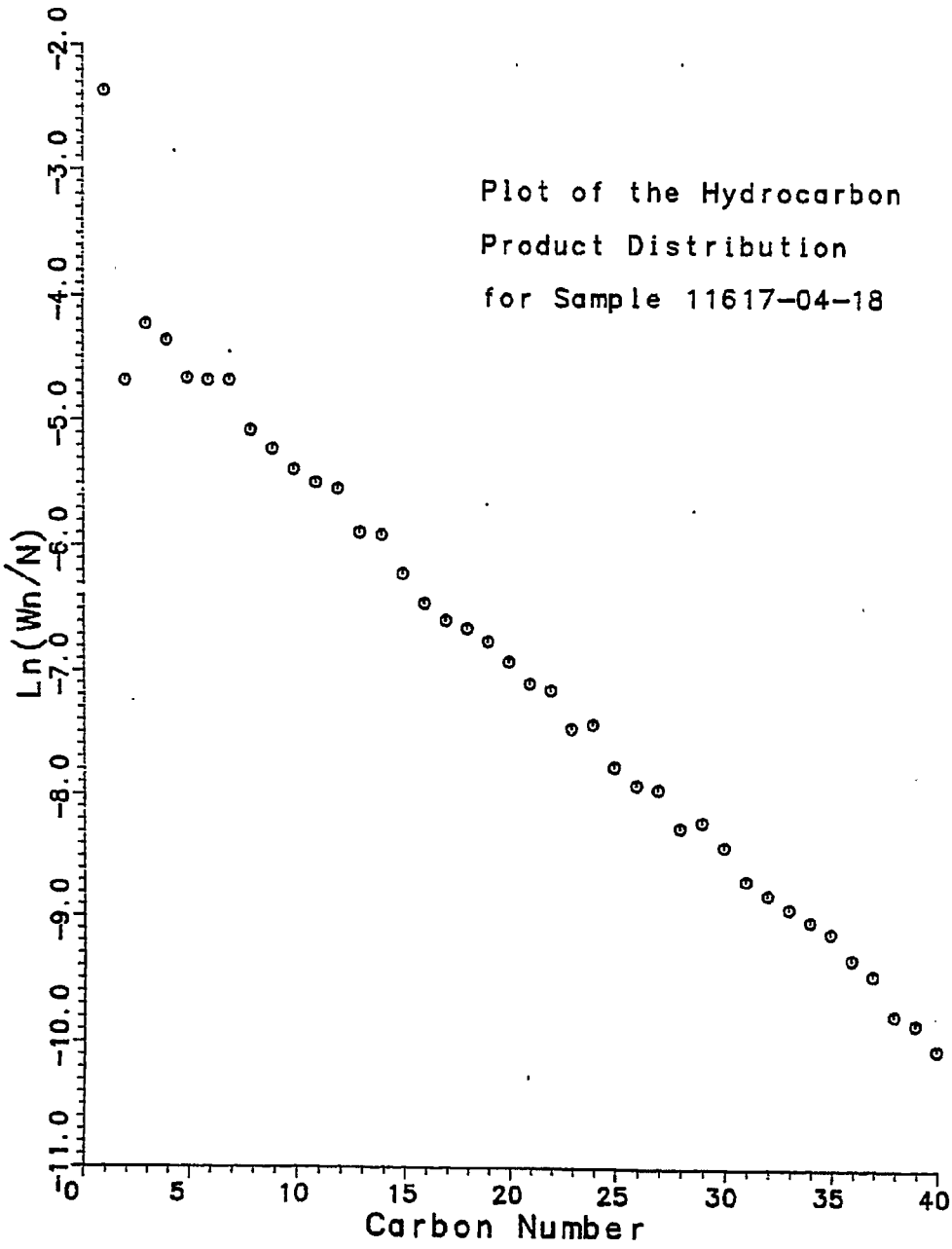

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-18
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B105

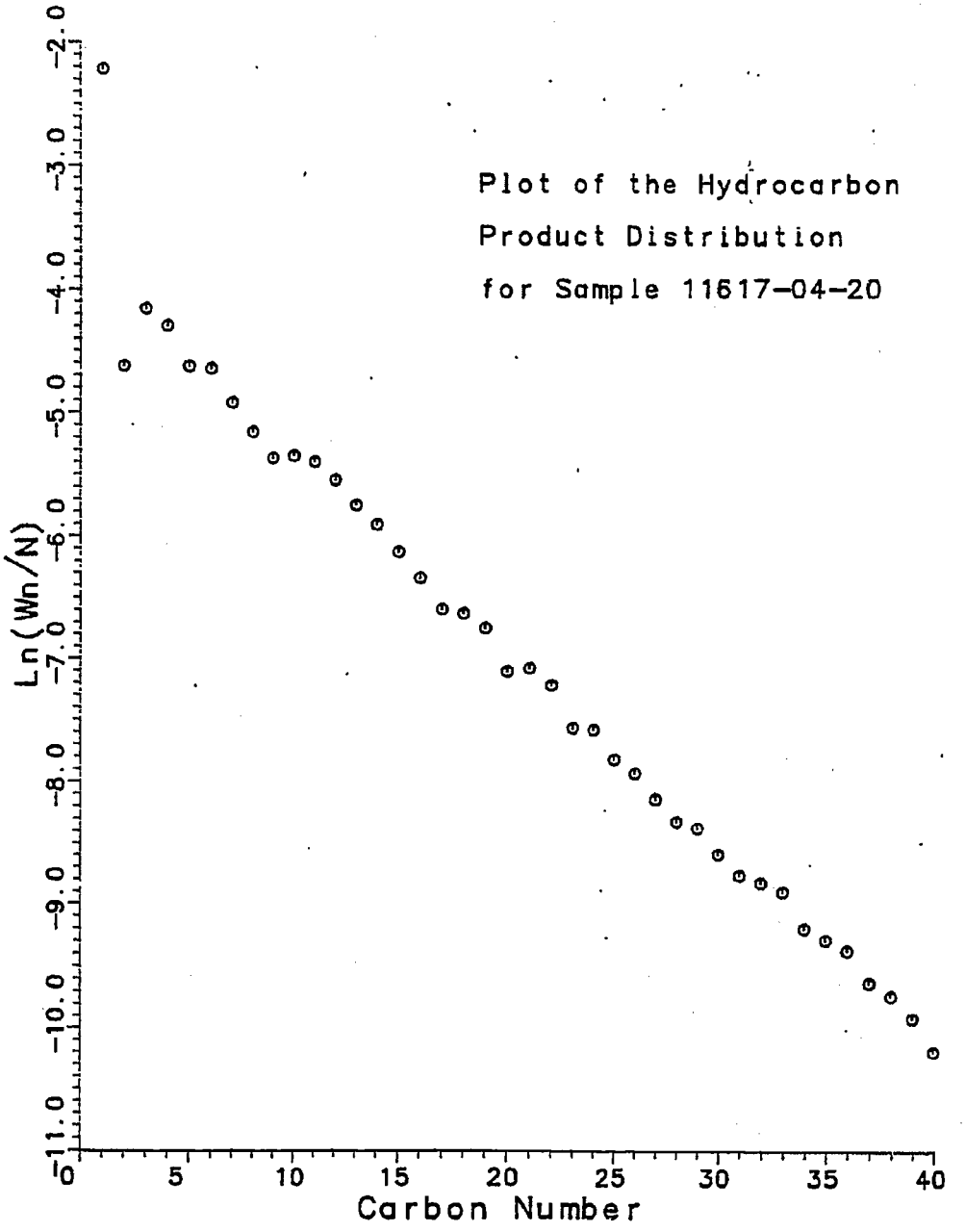

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-04-20
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B106

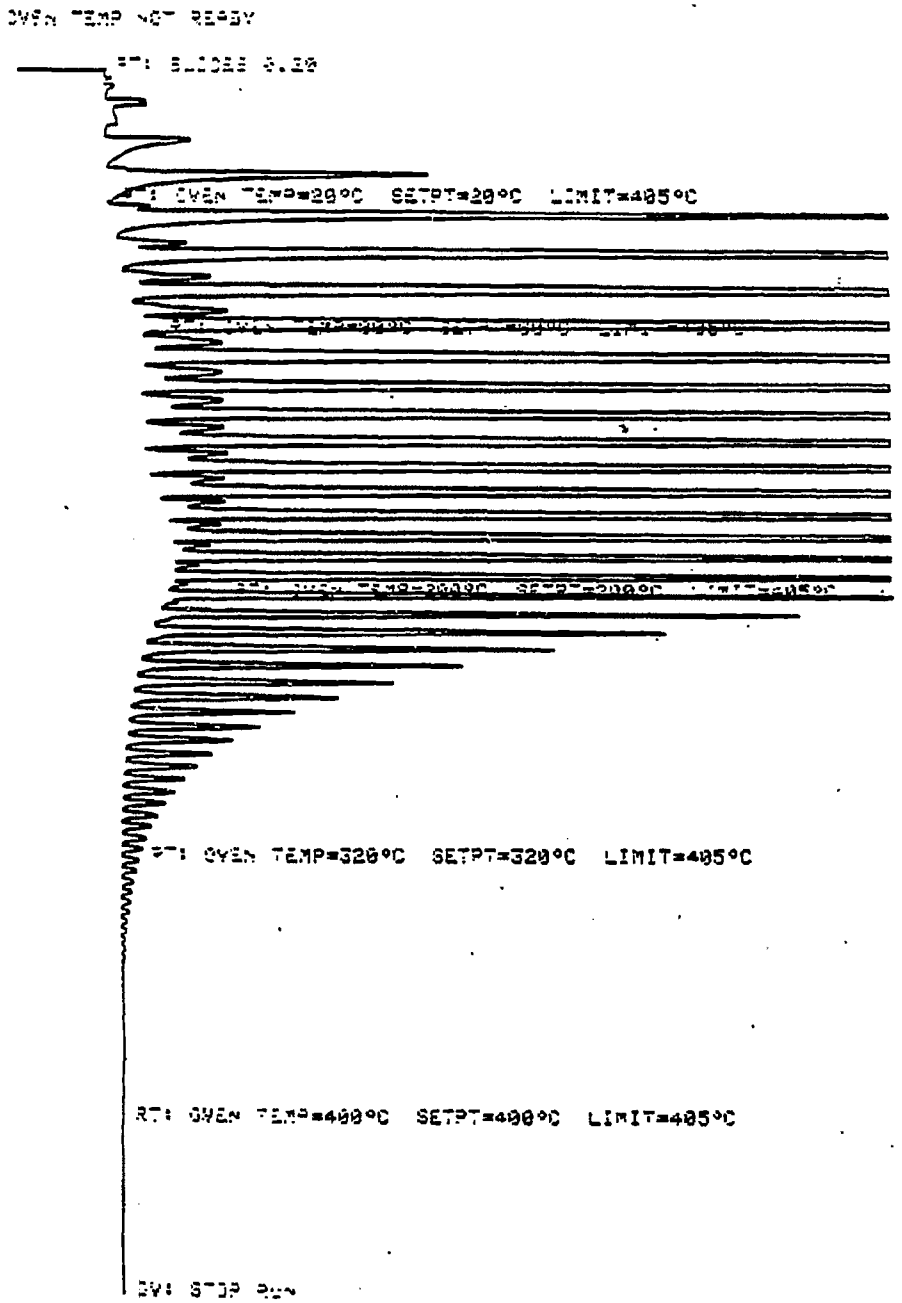
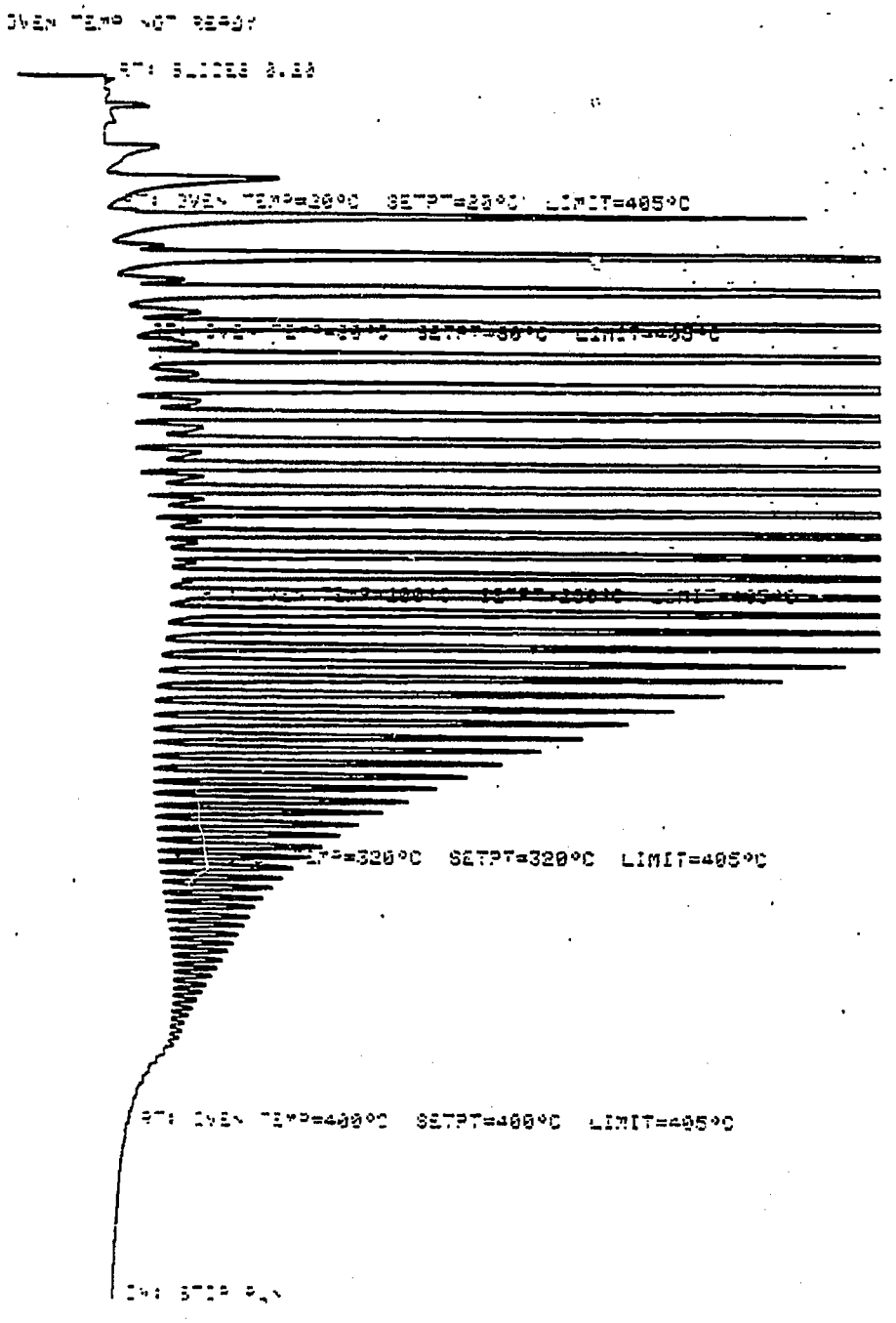

OVEN TEMP NOT READY
RT: OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
RT: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B107


OVEN TEMP NOT READY
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SETPT=320°C LIMIT=405°C
SETPT=400°C LIMIT=405°C

Fig. B108

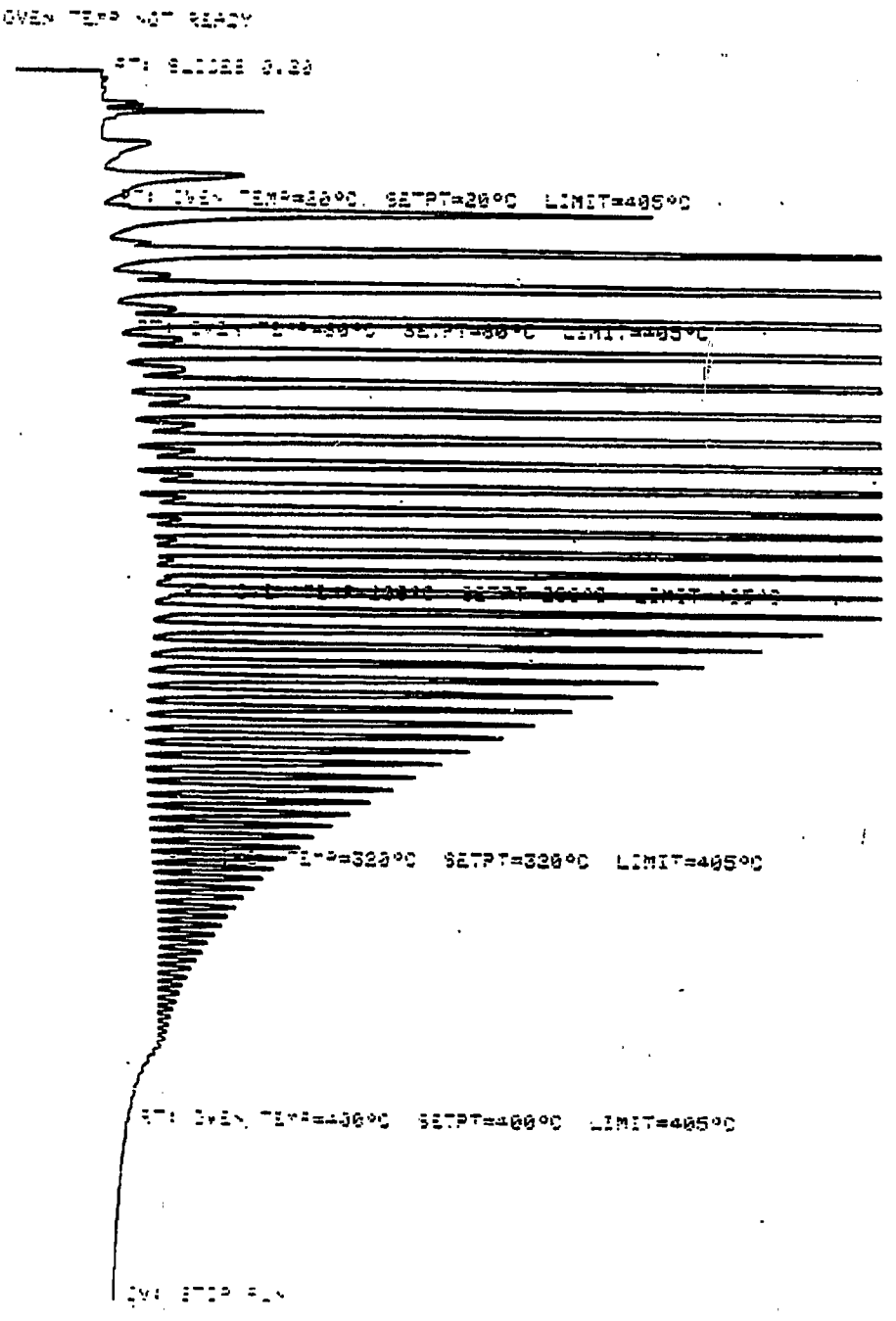


Fig. B109

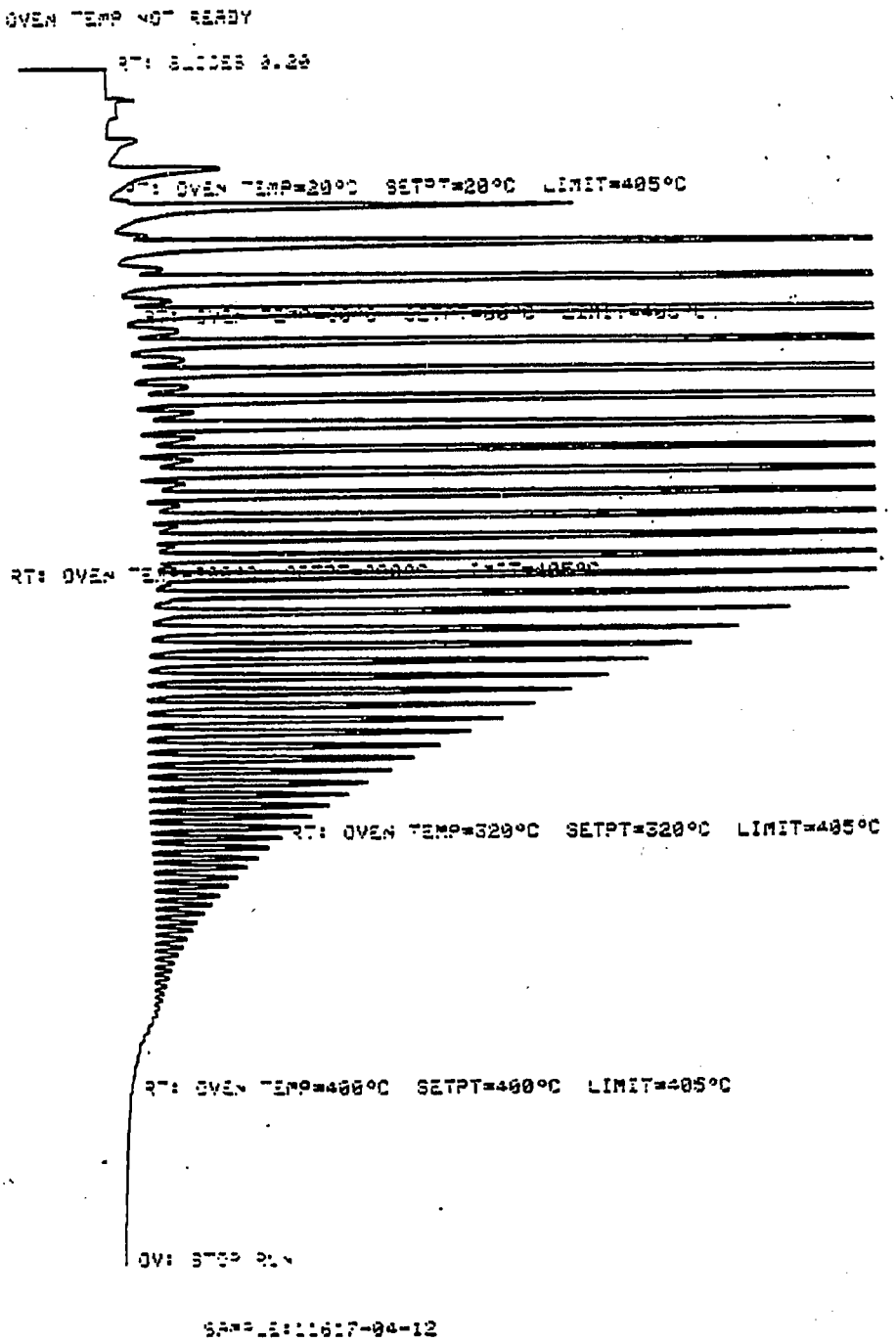

OVEN TEMP NOT READY
RT: OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
RT: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B110

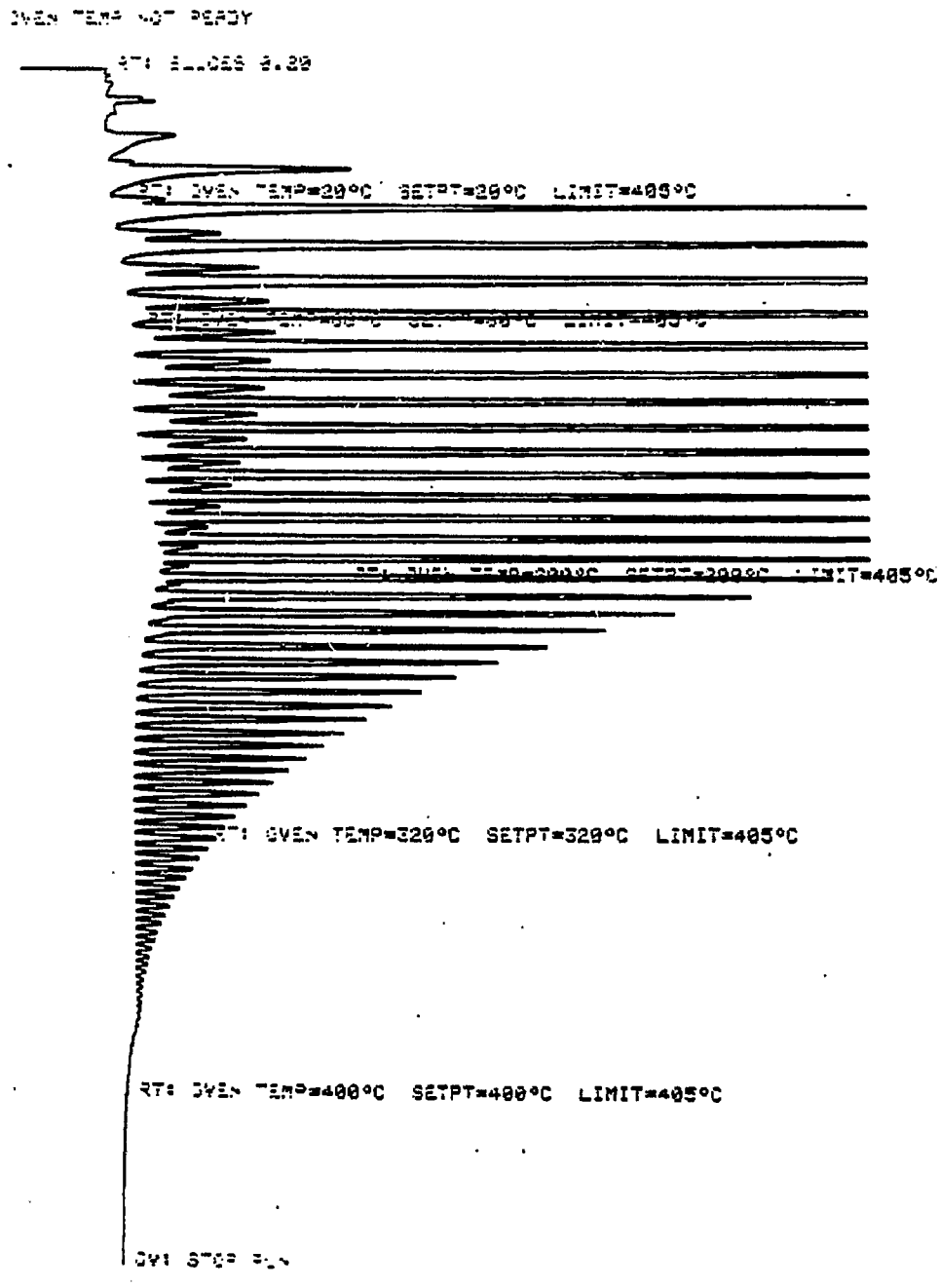

OVEN TEMP NOT READY
RT: OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
RT: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B111

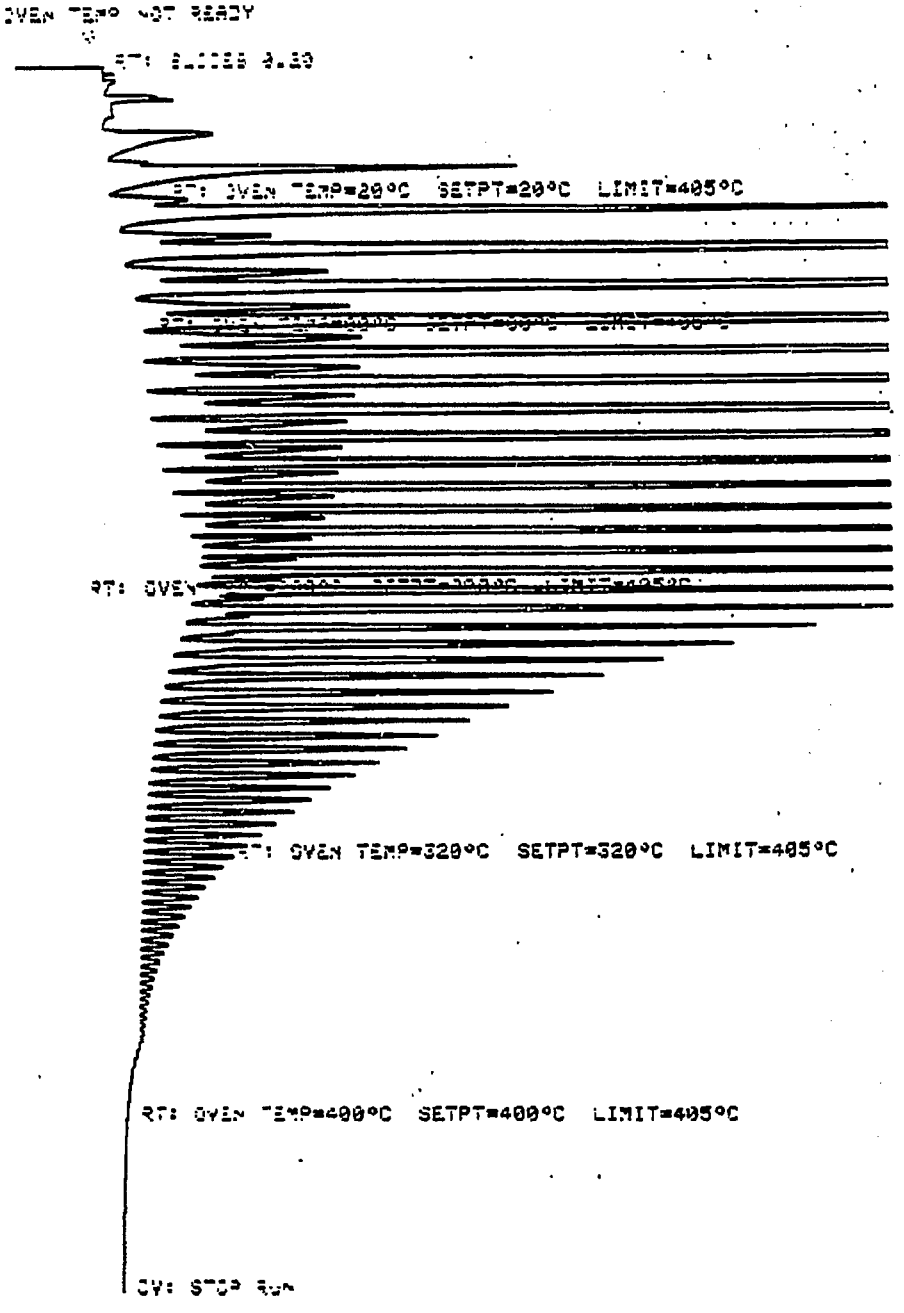

OVEN TEMP NOT READY
RT: OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
RT: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C
CV: STOP RUN

Fig. B112

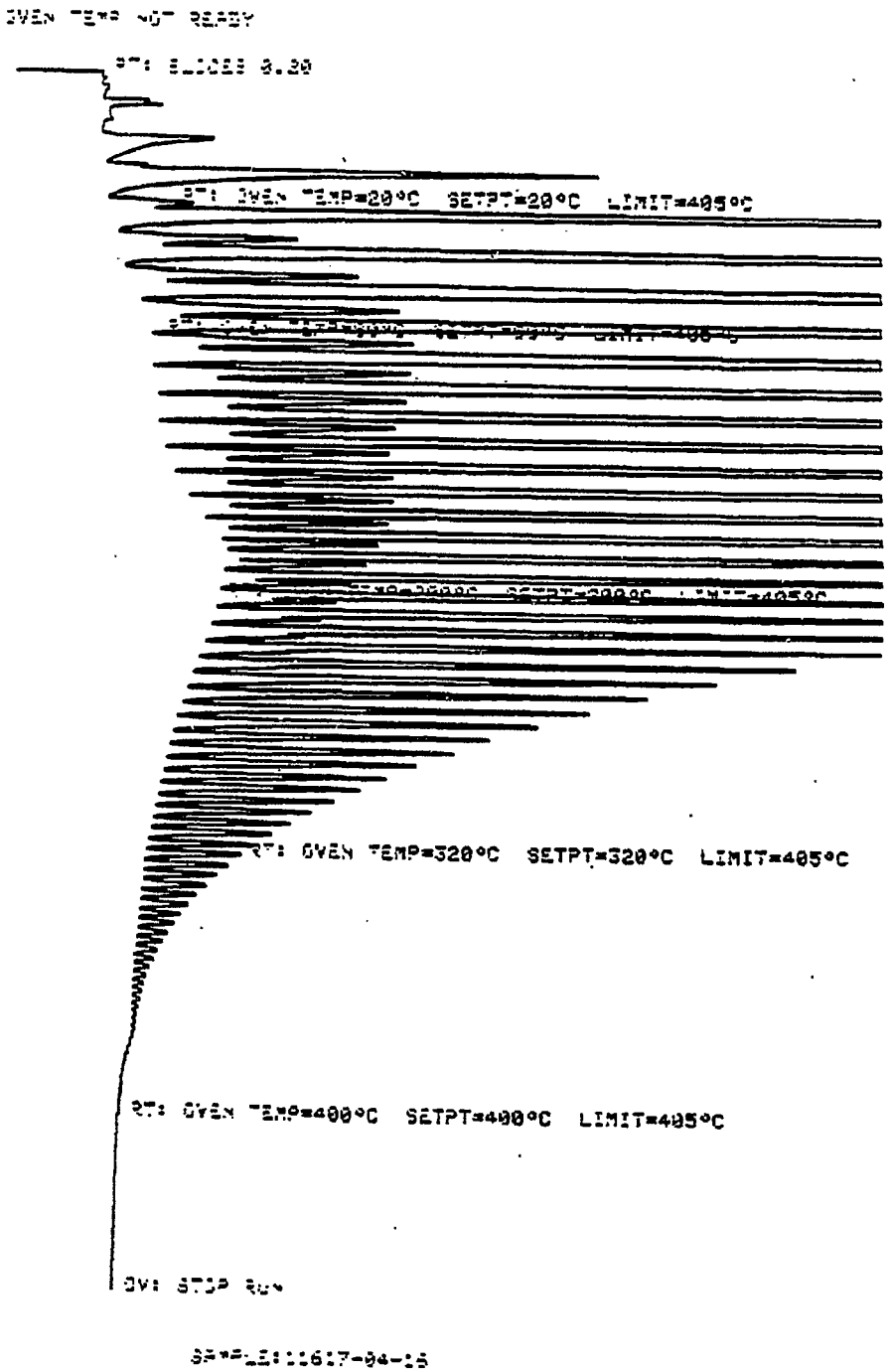

OVEN TEMP NOT READY
ST: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
ST: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B113

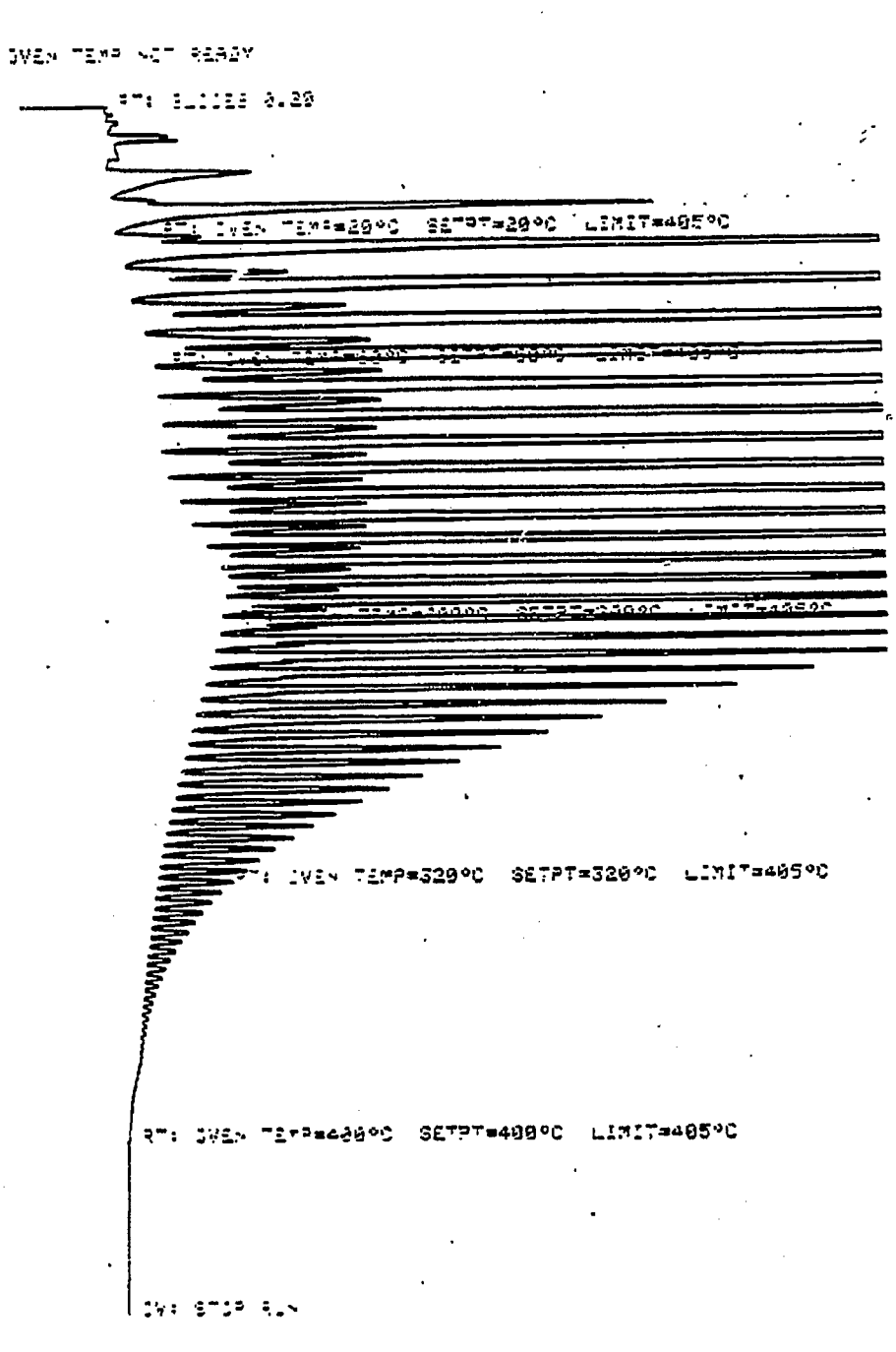

TGT
OVEN TEMP NOT READY
OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B114

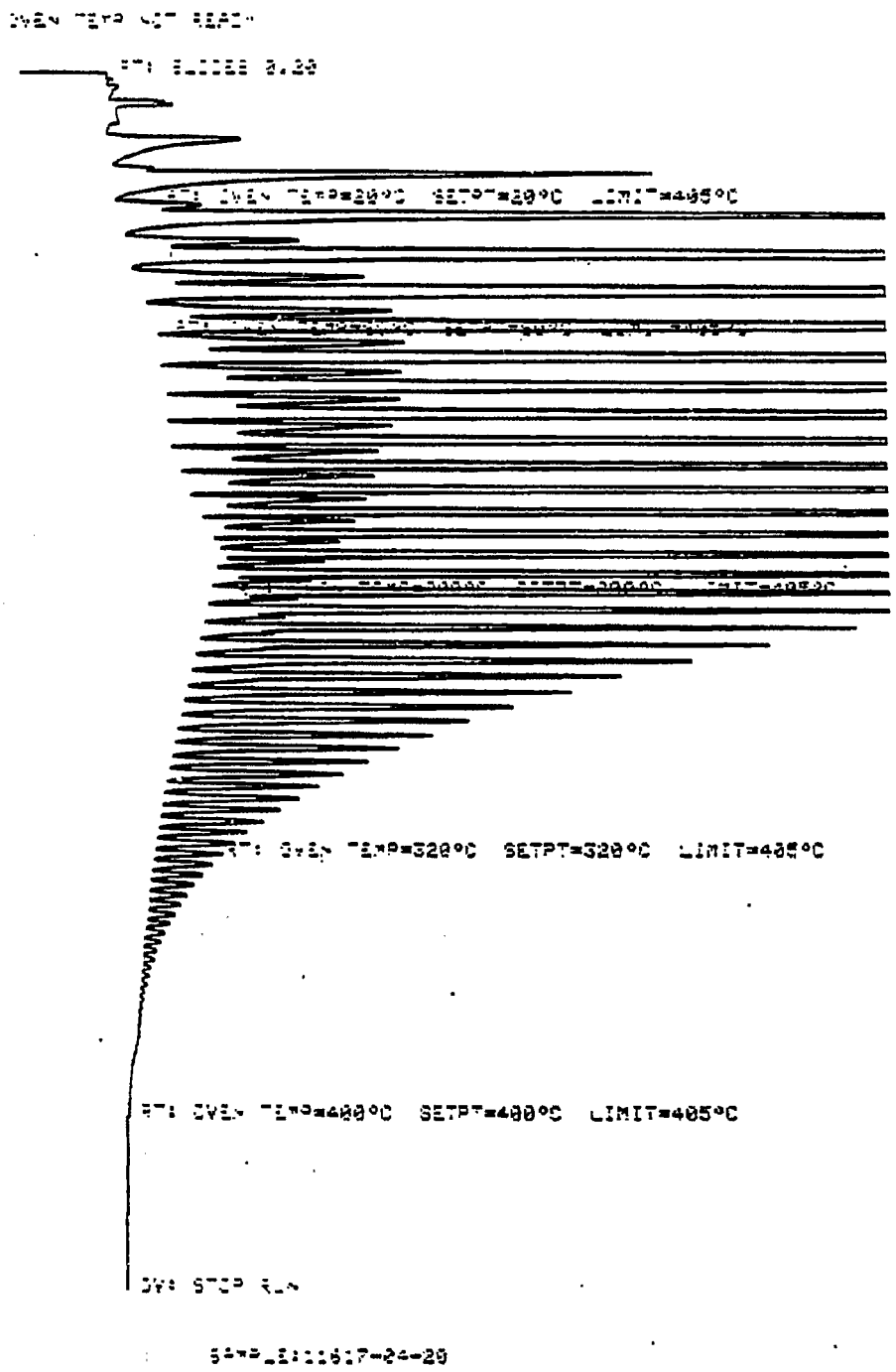

SET: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
SET: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B115

Table B11

FILE: 1161704A TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-C4
CATALYST CO/X11/X12-U103 250 CC 107.4 G AFTER USE:157.1 G (+49.7 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV (CAT#12524-3)

RUN & SAMPLE NO.	11617-04-01	617-04-02	617-04-03	617-04-09	617-04-10
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	24.0	44.0	68.0	236.0	260.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	242	239	239	240	240
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	24.00	20.00	24.00	24.00	24.00
EFFLNT GAS LITER	647.28	703.80	998.92	749.60	733.00
GM AQUEOUS LAYER	211.79	136.22	166.01	156.98	154.92
GM OIL	57.50	86.81	122.87	135.77	135.30
MATERIAL BALANCE					
GM ATOM CARBON %	62.66	85.53	99.25	83.51	81.53
GM ATOM HYDROGEN %	79.09	90.46	100.48	90.04	88.13
GM ATOM OXYGEN %	77.18	83.54	94.93	75.65	74.27
RATIO CHX/(H2O+CO2)	0.5765	1.0726	1.1536	1.3049	1.2855
RATIO X IN CHX	2.2358	2.2072	2.2155	2.1879	2.1868
USAGE H2/CO PRODT	2.5917	1.9018	1.8551	1.7907	1.7992
FEED H2/CO FRM EFFLNT	1.2622	1.0575	1.0124	1.0783	1.0810
RESIDUAL H2/CO RATIO	0.5824	0.5828	0.5769	0.5782	0.5798
RATIO CO2/(H2O+CO2)	0.0419	0.0496	0.0483	0.0325	0.0331
K SHIFT IN EFFLNT	0.0254	0.0304	0.0293	0.0194	0.0199
SPECIFIC ACTIVITY SA	3.0318	4.0479	3.8640	4.6345	4.6668
CONVERSION					
ON CO %	33.83	35.99	34.07	41.24	41.10
ON H2 %	69.47	64.73	62.43	68.49	68.41
ON CO+H2 %	53.71	50.76	48.34	55.38	55.29
PRDT SELECTIVITY,WT %					
CH4	6.46	4.82	4.86	3.51	3.42
C2 HC'S	1.16	1.03	0.94	0.84	0.73
C3H8	1.84	1.42	1.45	1.04	1.01
C3H6=	1.87	1.87	2.03	1.61	1.57
C4H10	2.04	1.55	1.59	1.18	1.13
C4H8=	2.21	2.08	2.34	1.95	1.93
C5H12	2.50	1.77	1.87	1.40	1.38
C5H10=	2.15	1.90	2.14	1.47	1.51
C6H14	2.97	2.01	2.13	1.90	1.78
C6H12= & CYCLO'S	1.38	1.31	1.44	1.29	1.30
C7+ IN GAS	20.78	13.62	8.03	7.67	6.19
LIQ HC'S	54.63	66.62	71.19	76.14	78.05
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	15.58	12.77	13.20	10.13	9.79
C5 -420 F	50.16	36.13	39.10	32.16	51.19
420-700 F	28.36	28.91	28.69	32.21	31.22
700-END PT	5.90	22.18	19.01	25.51	7.80

Table B11 (continued)

FILE: 1161704A TSS4Q1 A1

C5+-END PT	84.42	87.23	86.80	89.87	90.21
ISO/NORMAL MOLE RATIO					
C4	0.0135	0.0167	0.0000	0.0223	0.0000
C5	0.0541	0.0536	0.0504	0.0410	0.0411
C6	0.0426	0.0430	0.0193	0.1967	0.1799
C4=	0.0000	0.0000	0.0000	0.0578	0.0547
PARAFFIN/OLEFIN RATIO					
C3	0.9357	0.7219	0.6818	0.6130	0.6113
C4	0.8934	0.7196	0.6577	0.5820	0.5640
C5	1.1304	0.9069	0.8499	0.9239	0.8848
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8384	0.8765	0.8682	0.8900	0.8331
RATIO CH4/(1-A)**2	2.4754	3.1654	2.7948	2.8994	1.2271
ALPHA FRM CORRELATION	0.8382	0.8383	0.8388	0.8386	
ALPHA (EXPTL/CORR)	1.0003	1.0456	1.0350	1.0613	
W%CH4 FRM CORRELATION	14.1027	13.3760	13.2230	13.5044	
W%CH4 (EXPTL/CORR)	0.4581	0.3606	0.3674	0.2597	
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLD OIL	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	293	342	297	339	
16	333	381	338	379	
50	477	591	527	582	
84	660	862	814	865	
90	705	944	892	944	
RANGE(16-84 %)	327	481	476	486	
WT % @ 420 F	37.30	23.30	33.00	24.20	50.00
WT % @ 700 F	89.20	66.70	73.30	66.50	90.00

Table B12

FILE: 1161704B TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-04
CATALYST CO/X11/X12-U103 250 CC 107.4 G AFTER USE:157.1 G (+49.7 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV (CAT#12524-3)

RUN & SAMPLE NO.	11617-04-11	617-04-12	617-04-13	617-04-14	617-04-15
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	308.7	333.0	357.0	381.0	405.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	240	240	259	260	260
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	48.75	24.25	24.00	24.00	24.00
EFFLNT GAS LITER	1857.90	924.40	836.16	881.28	864.00
GM AQUEOUS LAYER	349.89	164.60	177.30	191.55	204.92
GM OIL	249.98	135.00	126.83	146.09	114.73
MATERIAL BALANCE					
GM ATOM CARBON %	93.21	95.34	99.00	106.78	100.78
GM ATOM HYDROGEN %	97.38	97.61	97.96	106.74	102.83
GM ATOM OXYGEN %	89.75	88.62	93.98	98.34	98.26
RATIO CHX/(H2O+CO2)	1.1211	1.2473	1.1459	1.2363	1.0681
RATIO X IN CHX	2.2078	2.1948	2.2978	2.2679	2.2751
USAGE H2/CO PRODT	1.9005	1.8139	1.6085	1.6231	1.7500
FEED H2/CO FRM EFFLNT	1.0448	1.0238	0.9895	0.9996	1.0203
RESIDUAL H2/CO RATIO	0.5736	0.5674	0.4611	0.4603	0.4530
RATIO CO2/(H2O+CO2)	0.0369	0.0378	0.1815	0.1507	0.1258
K SHIFT IN EFFLNT	0.0220	0.0223	0.1022	0.0817	0.0652
SPECIFIC ACTIVITY SA	3.8782	4.0829	2.6784	2.5728	2.4247
CONVERSION					
ON CO %	35.51	36.62	46.06	46.38	43.74
ON H2 %	64.59	64.87	74.87	75.31	75.02
ON CO+H2 %	50.37	50.91	60.38	60.85	59.54
PRDT SELECTIVITY,WT %					
CH4	4.43	4.08	8.97	7.81	8.36
C2 HC'S	1.11	0.93	1.73	1.61	1.67
C3H8	1.27	1.21	2.22	1.37	2.05
C3H6=	2.01	1.90	2.00	1.89	2.15
C4H10	1.42	1.37	2.06	1.82	1.99
C4H8=	2.48	2.39	2.90	2.74	2.94
C5H12	1.76	1.68	2.46	2.19	2.37
C5H10=	1.91	1.81	1.92	1.82	2.00
C6H14	2.43	0.36	3.54	3.14	3.22
C6H12= & CYCLO'S	1.67	3.01	1.45	1.51	1.45
C7+ IN GAS	7.24	7.00	10.50	12.11	17.33
LIQ HC'S	72.27	74.26	60.25	62.00	54.48
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	12.72	11.88	19.88	17.23	19.15
C5 -420 F	51.14	31.98	39.46	41.85	53.61
420-700 F	28.91	32.08	27.41	27.40	21.79
700-END PT	7.23	24.06	13.25	13.52	5.45

Table B12 (continued)

FILE: 1161704B TSS4Q1 A1

C5+-END PT	87.28	88.12	80.12	82.77	80.85
ISO/NORMAL MOLE RATIO					
C4	0.0000	0.0000	0.0148	0.0143	0.0167
C5	0.0464	0.0464	0.0754	0.0678	0.0754
C6	0.1732	0.0000	0.3905	0.3658	0.3566
C4=	0.0546	0.0599	0.0732	0.0731	0.0735
PARAFFIN/OLEFIN RATIO					
C3	0.6019	0.6103	1.0578	0.6900	0.9092
C4	0.5534	0.5512	0.6845	0.6414	0.6514
C5	0.8945	0.9009	1.2499	1.1709	1.1496
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8440	0.8872	0.8579	0.8599	0.8104
RATIO CH4/(1-A)**2	1.8201	3.2034	4.4438	3.9776	2.3249
ALPHA FRM CORRELATION		0.8396	0.8486	0.8486	
ALPHA (EXPTL/CORR)		1.0567	1.0110	1.0133	
W%CH4 FRM CORRELATION		13.2172	14.5807	14.7835	
W%CH4 (EXPTL/CORR)		0.3085	0.6153	0.5282	
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F		330	290	289	
16		371	331	331	
50		582	524	506	
84		850	757	753	
90		921	838	828	
RANGE(16-84 %)		479	426	422	
WT % @ 420 F	50.00	24.40	32.50	34.00	50.00
WT % @ 700 F	90.00	67.60	78.00	78.20	90.00

Table B13

FILE: 1161704C TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-04
CATALYST CO/X11/X12-U103 250 CC 107.4 G AFTER USE:157.1 G (+49.7 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV (CAT#12524-3)

RUN & SAMPLE NO.	11617-04-16	617-04-17	617-04-18	617-04-19	617-04-20
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	429.0	453.5	505.0	526.0	553.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	260	260	260	260	261
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	24.00	24.50	51.50	21.00	27.00
EFFLNT GAS LITER	864.33	882.98	1862.76	773.64	1015.20
GM AQUEOUS LAYER	206.89	203.83	429.31	180.37	227.25
GM OIL	108.58	113.50	237.23	90.83	114.41
MATERIAL BALANCE					
GM ATOM CARBON %	97.56	98.15	97.52	96.38	96.99
GM ATOM HYDROGEN %	100.85	100.91	101.05	99.45	99.99
GM ATOM OXYGEN %	97.90	96.37	95.17	98.32	98.35
RATIO CHX/(H2O+CO2)	0.9907	1.0500	1.0682	0.9462	0.9614
RATIO X IN CHX	2.2986	2.2976	2.3044	2.3217	2.3374
USAGE H2/CO PRODT	1.8253	1.7978	1.8595	1.9157	1.9166
FEED H2/CO FRM EFFLNT	1.0337	1.0281	1.0361	1.0318	1.0309
RESIDUAL H2/CO RATIO	0.4634	0.4672	0.4679	0.4657	0.4758
RATIO CO2/(H2O+CO2)	0.1169	0.1139	0.0855	0.0980	0.0964
K SHIFT IN EFFLNT	0.0613	0.0600	0.0437	0.0506	0.0507
SPECIFIC ACTIVITY SA	2.1664	2.1555	2.0566	1.9518	1.7539
CONVERSION					
ON CO %	41.88	42.15	40.83	39.04	38.53
ON H2 %	73.94	73.71	73.28	72.49	71.63
ON CO+H2 %	58.18	58.15	57.35	56.02	55.33
PRDT SELECTIVITY,WT %					
CH4	9.19	8.97	9.44	10.14	10.95
C2 HC'S	1.92	1.72	1.85	1.93	1.97
C3H8	2.20	2.23	2.25	2.45	2.46
C3H6=	2.20	2.15	2.12	2.37	2.26
C4H10	2.14	2.26	2.19	2.37	2.36
C4H8=	3.10	3.13	2.92	3.20	3.11
C5H12	2.68	2.89	2.64	2.77	2.85
C5H10=	2.16	2.27	2.08	2.80	2.07
C6H14	3.84	4.32	3.86	3.80	4.00
C6H12= & CYCLO'S	1.44	1.62	1.71	1.85	1.79
C7+ IN GAS	13.58	12.75	12.89	9.48	10.37
LIQ HC'S	55.55	55.69	56.03	56.83	55.82
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	20.74	20.46	20.78	22.46	23.10
C5 -420 F	42.59	51.70	40.55	49.12	38.94
420-700 F	24.72	22.28	25.94	22.73	26.52
700-END PT	11.94	5.57	12.72	5.68	11.44

Table B13 (continued)

FILE: 11617[illegible] TSS4Q1 A1

C5+-END PT	79.26	79.54	79.22	77.54	76.90
ISO/NORMAL MOLE RATIO					
C4	0.0153	0.0150	0.0147	0.0174	0.0120
C5	0.0685	0.0623	0.0603	0.0683	0.0701
C6	0.3376	0.3137	0.3060	0.1946	0.3083
C4=	0.0724	0.0760	0.0765	0.0807	0.0776
PARAFFIN/OLEFIN RATIO					
C3	0.9547	0.9697	1.0101	0.9851	1.0392
C4	0.6682	0.6995	0.7245	0.7162	0.7327
C5	1.2063	1.2370	1.2317	0.9625	1.3385
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8513	0.8671	0.8542	0.8331	0.8490
RATIO CH4/(1-A)**2	4.1567	5.0779	4.4417	3.6393	4.8002
ALPHA FRM CORRELATION	0.8483		0.8478		0.8469
ALPHA (EXPTL/CORR)	1.0036		1.0076		1.0024
W%CH4 FRM CORRELATION	14.8856		15.0311		15.5105
W%CH4 (EXPTL/CORR)	0.6171		0.6281		0.7057
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	292		303		304
16	334		344		344
50	507		519		504
84	750		757		742
90	820		828		816
RANGE(16-84 %)	416		413		398
WT % @ 420 F	34.00	50.00	31.00	50.00	32.00
WT % @ 700 F	78.50	90.00	77.30	90.00	79.50

VIII. Run 40 (12185-19) with Catalyst 40 ($Co/X_{11}/X_3/TC-103$)
Run 41 (11617-03) with Catalyst 41 ($Co/X_{11}/TC-103$)

These runs tested the use of the promoter X_{11} in two catalysts with formulations otherwise similar to that of Catalyst 15 of the Third Quarterly Report; Catalyst 40 contained, in addition, a small quantity of X_3. The method of formulation was first developed during the previous contract, DE-AC22-81PC40077.

In Catalyst 40 the concentrations of cobalt, X_{11} and X_3, respectively, were 8.2, 1.6 and 0.06 percent. In Catalyst 41 the concentrations of cobalt and X_{11}, respectively, were 12.3 and 2.4 percent.

For Catalyst 40, the conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B116-119. Simulated distillations of the C_5^+ product are plotted in Figs. B120-122. Carbon number product distributions are plotted in Figs. B123-125. Chromatograms from simulated distillations are reproduced in Figs. B126-128. Detailed material balances appear in Tables B14-15.

For Catalyst 41, the conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B129-132. Simulated distillations of the C_5^+ product are plotted in Figs. B133-135. Carbon

number product distributions are plotted in Figs. B136-138. Chromatograms from simulated distillations are reproduced in Figs. B139-141. Detailed material balances appear in Table B16.

Catalyst 40 was run for 187 hours at 260C, Catalyst 41 for about 58 hours at 240C followed by about 32 hours at 260C.

The activity of Catalyst 40, about 55 percent conversion of $CO+H_2$, was comparable to that of Catalyst 32--relatively as well as absolutely since the cobalt concentration was the same in both. With Catalyst 41, in contrast, containing 4 percent more cobalt, the conversion was only about 49 percent at 260C. The performance of Catalyst 41 was inferior as well to that of Catalyst 38, which contained the same 12.3 percent concentration of cobalt and converted about 54 percent of syngas.

The catalysts demonstrated similar selectivity trends as previous X_{11} catalysts formulated using the method first used in Run 11--low methane, high C_5^+ yields and high olefin contents.

Both runs were too short for any useful conclusions as to the stability of the catalysts.

As in Run 32, both Schulz-Flory plots were linear except for the usual high methane. Isomerization was also at the usual low level of less than 10 percent in the C_5^+ fraction.

These runs have further confirmed the effectiveness of the additive X_{11} as a promoter in catalysts formulated by the method used for Catalyst 15.

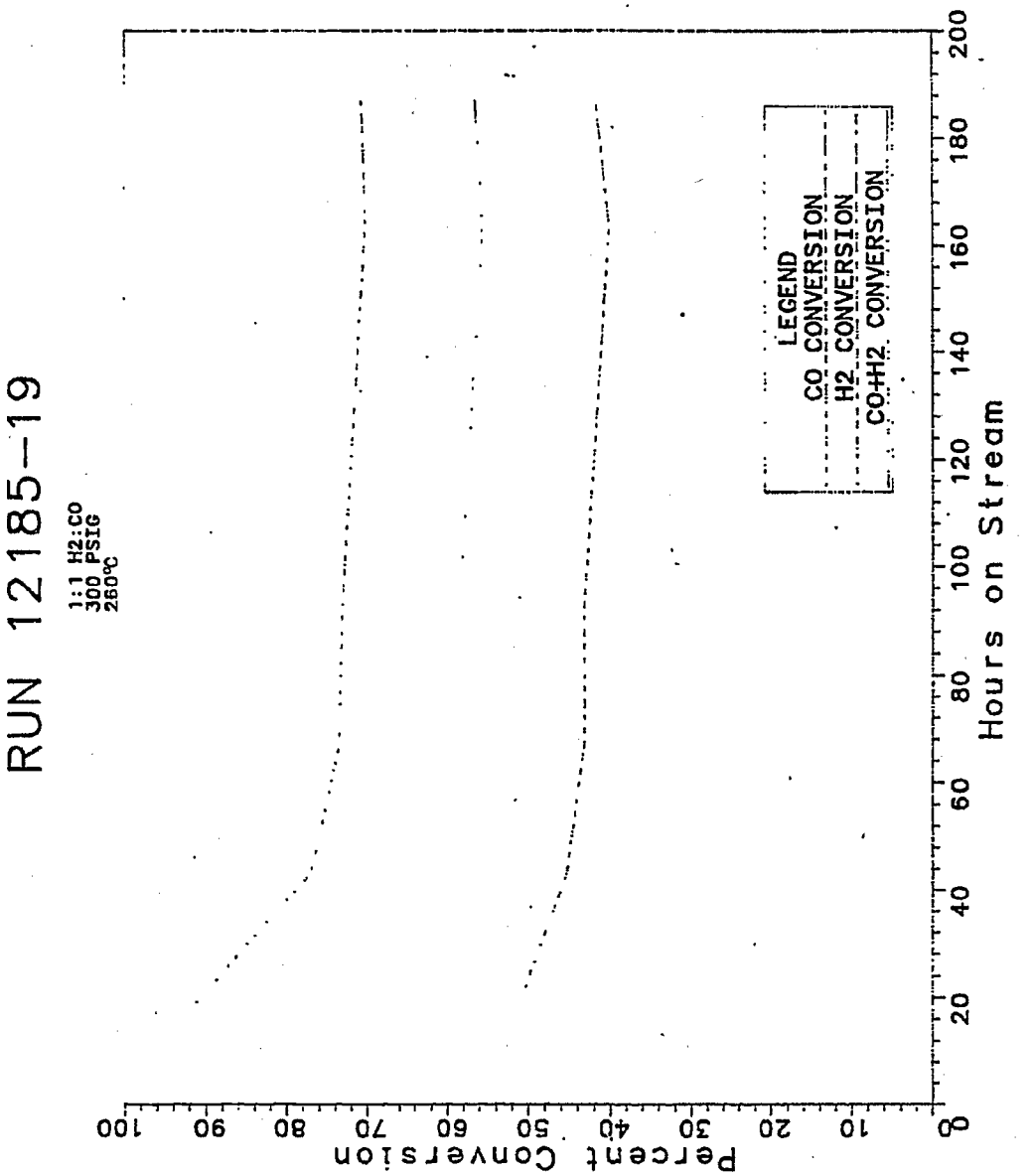
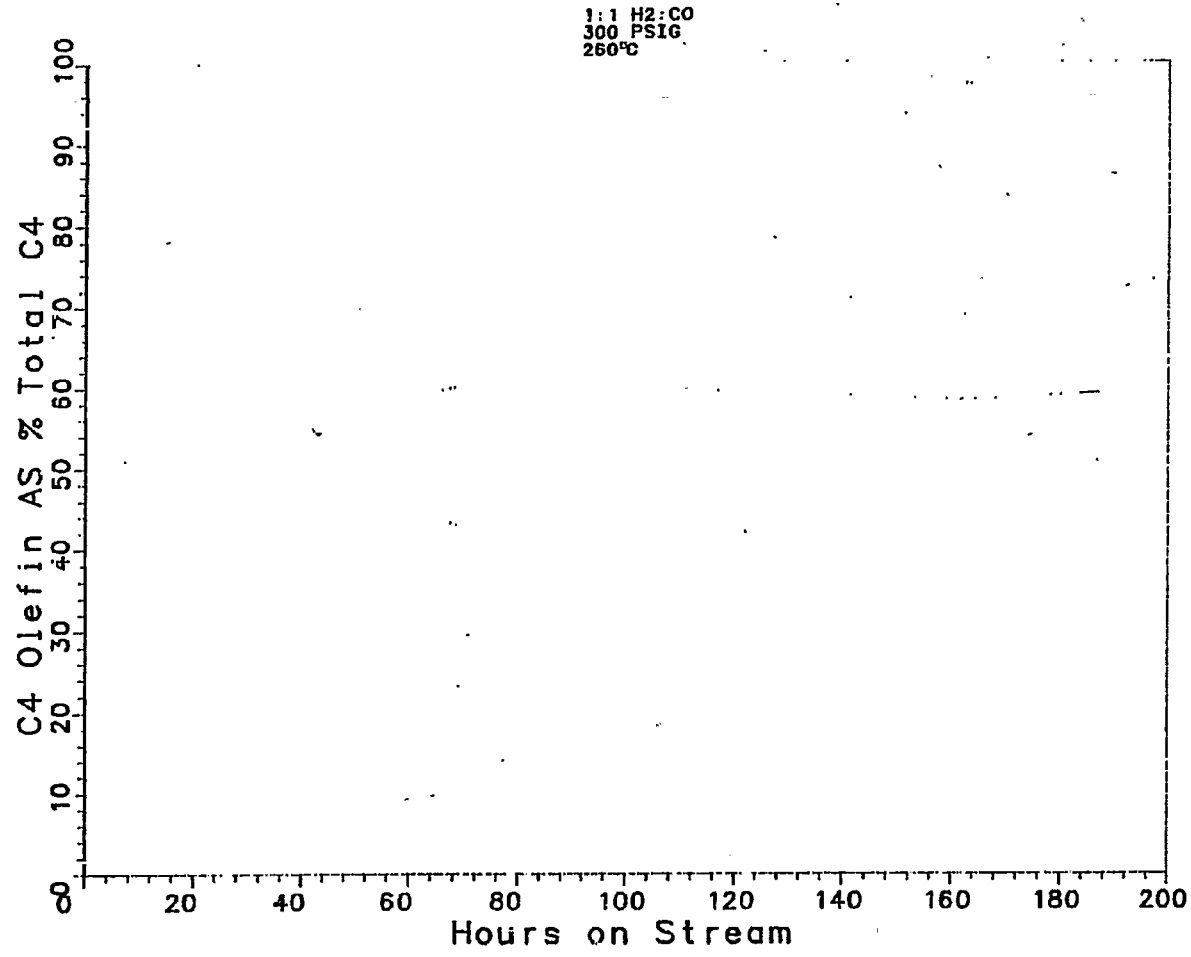

RUN 12185-19
1:1 H2:CO
300 PSIG
260°C
LEGEND
CO CONVERSION
H2 CONVERSION
CO+H2 CONVERSION
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
120
140
160
180
200

Fig. B116

Fig. B117

RUN 12185-19



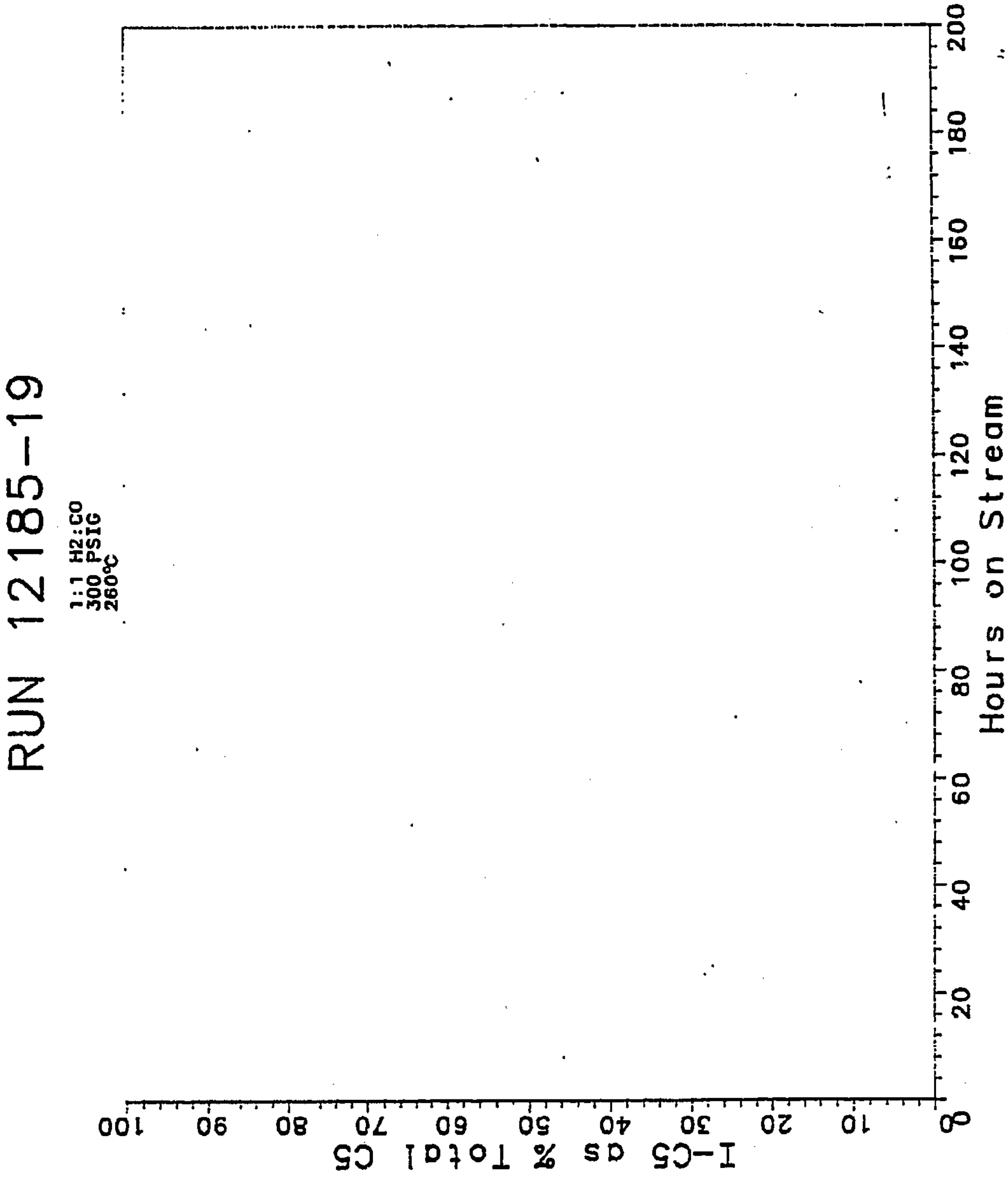

RUN 12185-19
1:1 H2:CO
300 PSIG
260°C
Hours on Stream
0
20
40
60
80
100
120
140
160
180
200
I-C5 as % Total C5
0
10
20
30
40
50
60
70
80
90
100

Fig. B118

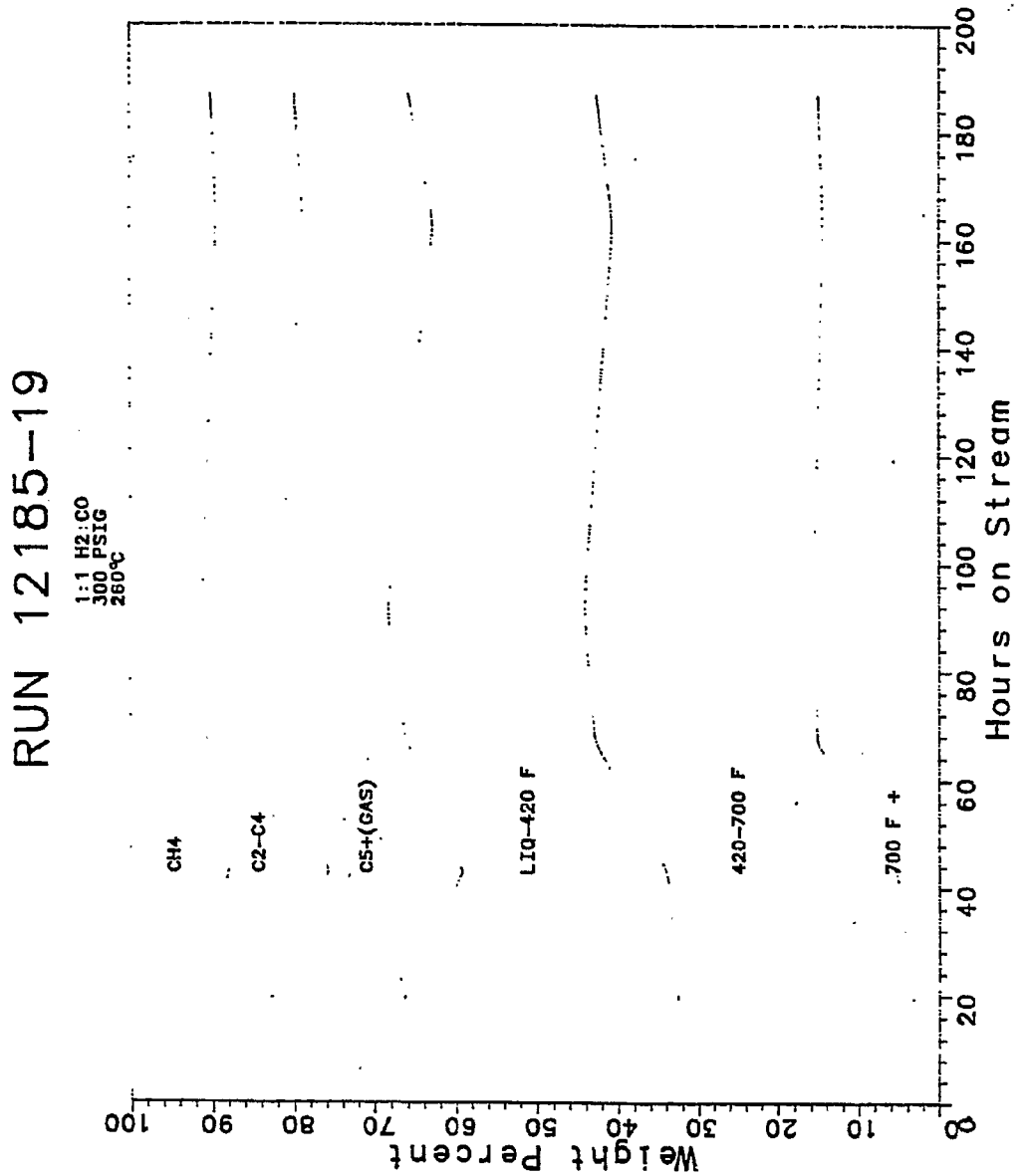

RUN 12185-19
1:1 H2:CO
300 PSIG
260°C
CH4
C2-C4
C5+(GAS)
LIQ-420 F
420-700 F
700 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
20
40
60
80
100
120
140
160
180
200

Fig. B119

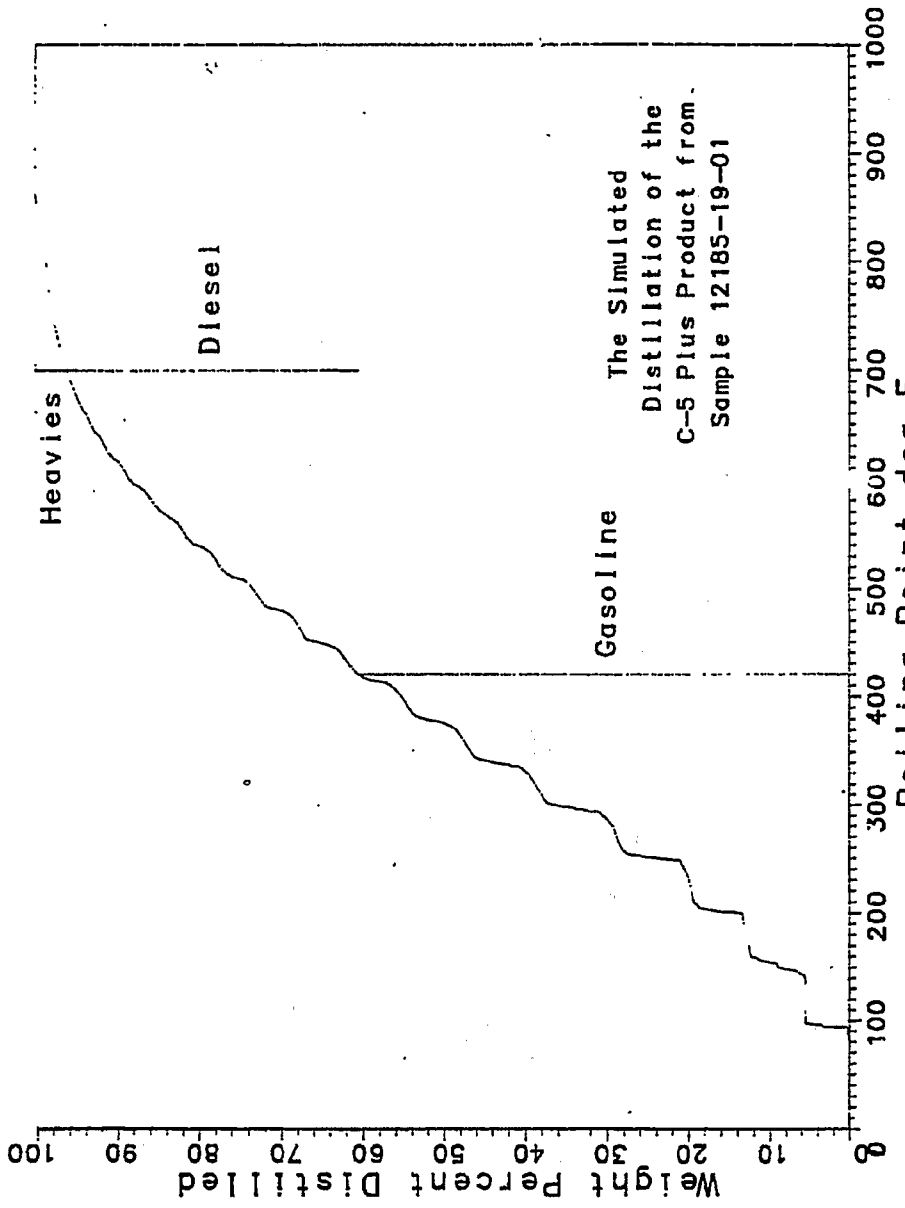

The Simulated
Distillation of the
C-5 Plus Product from
Sample 12185-19-01
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B120

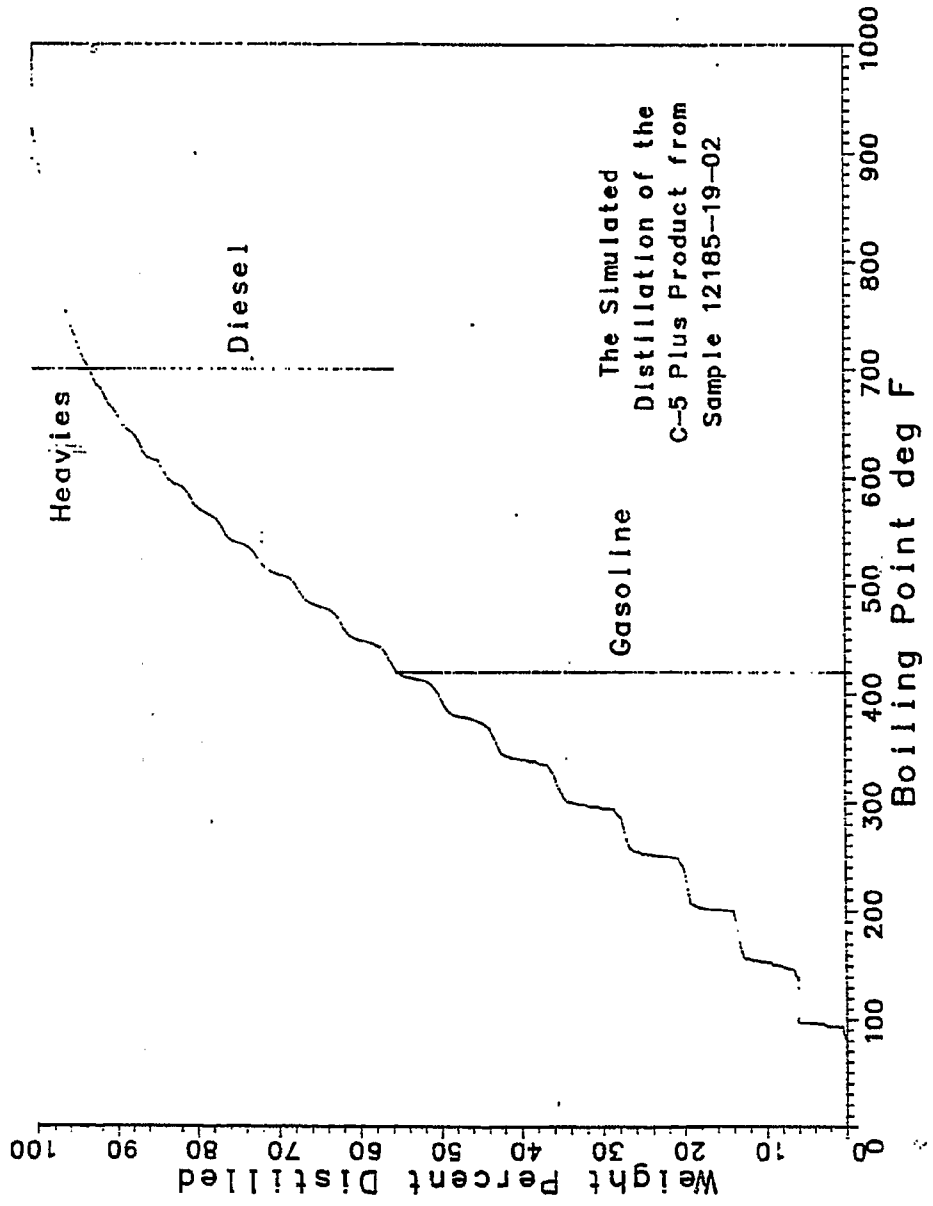

The Simulated
Distillation of the
C-5 Plus Product from
Sample 12185-19-02
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. B121

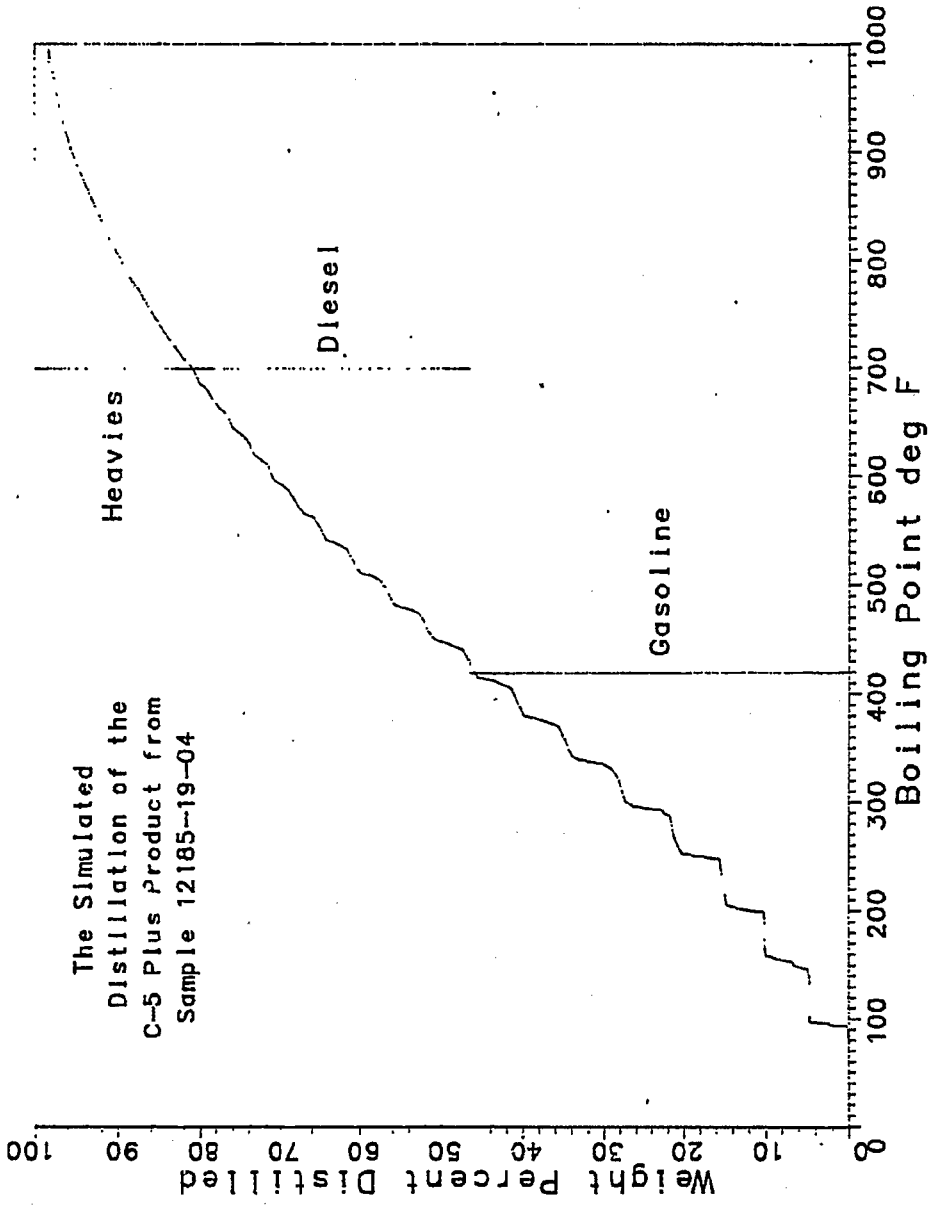

The Simulated
Distillation of the
C-5 Plus Product from
Sample 12185-19-04
Heavies
Diesel
Gasoline
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point deg F
100
200
300
400
500
600
700
800
900
1000

Fig. B122

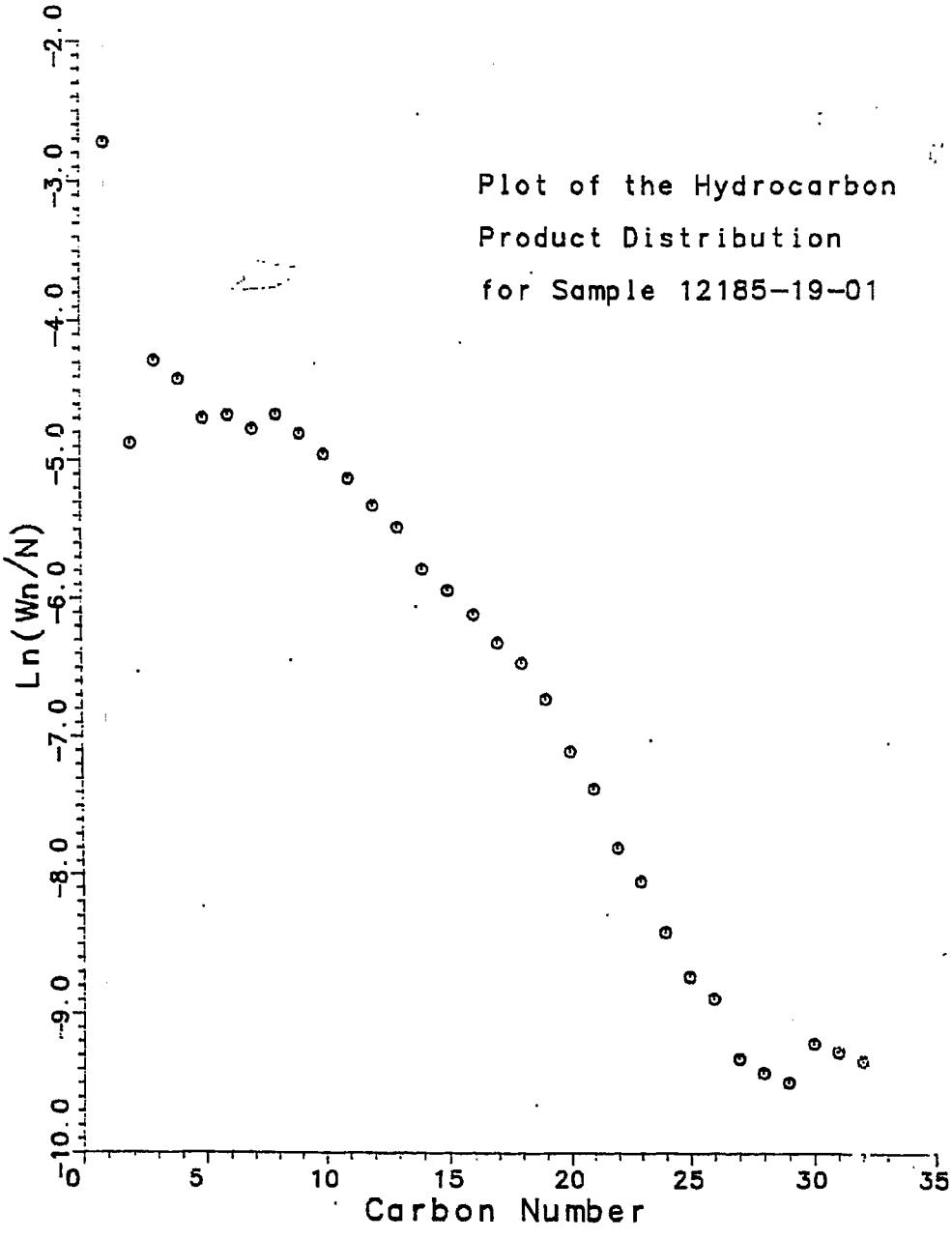

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-19-01
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. B123

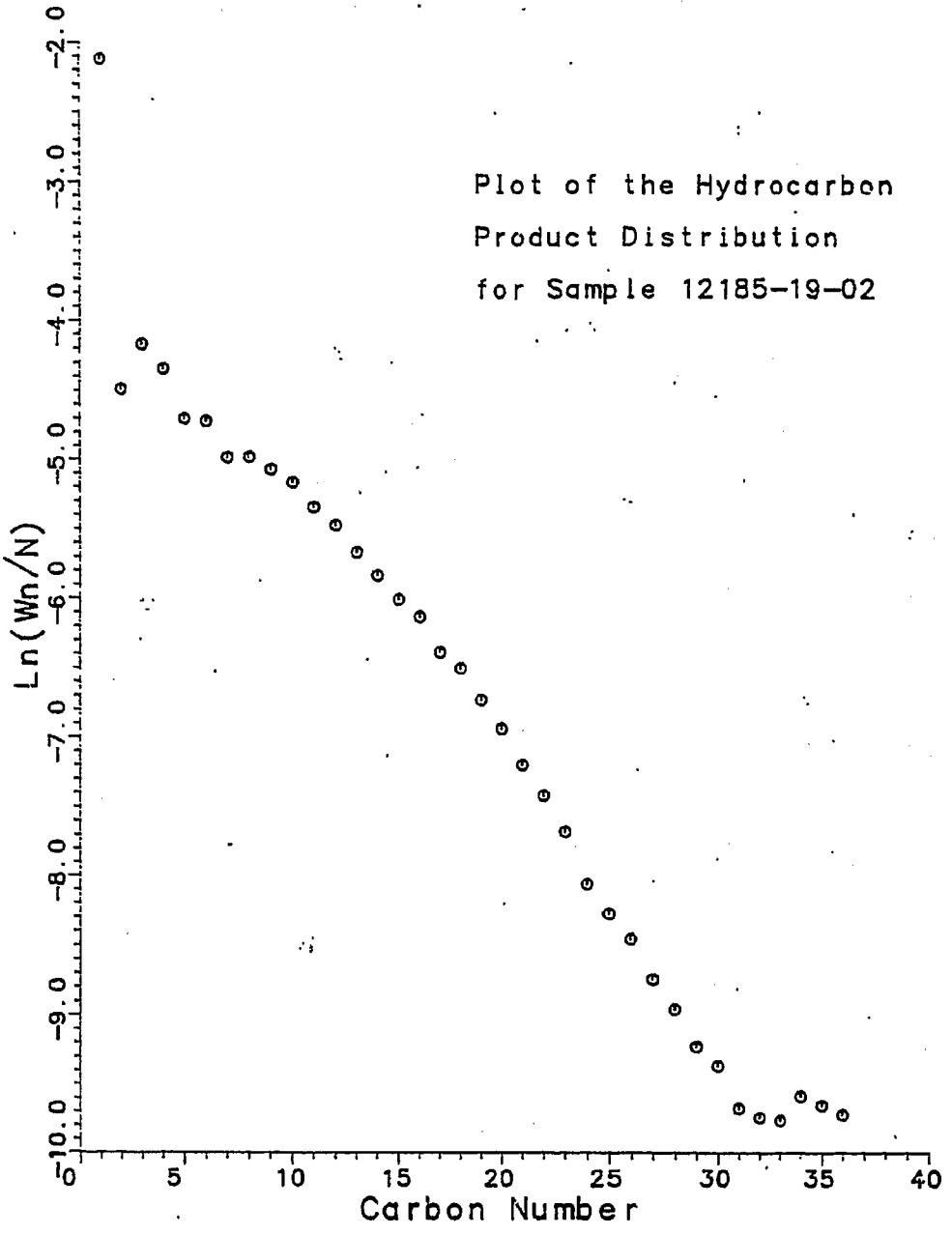

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-19-02
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B124

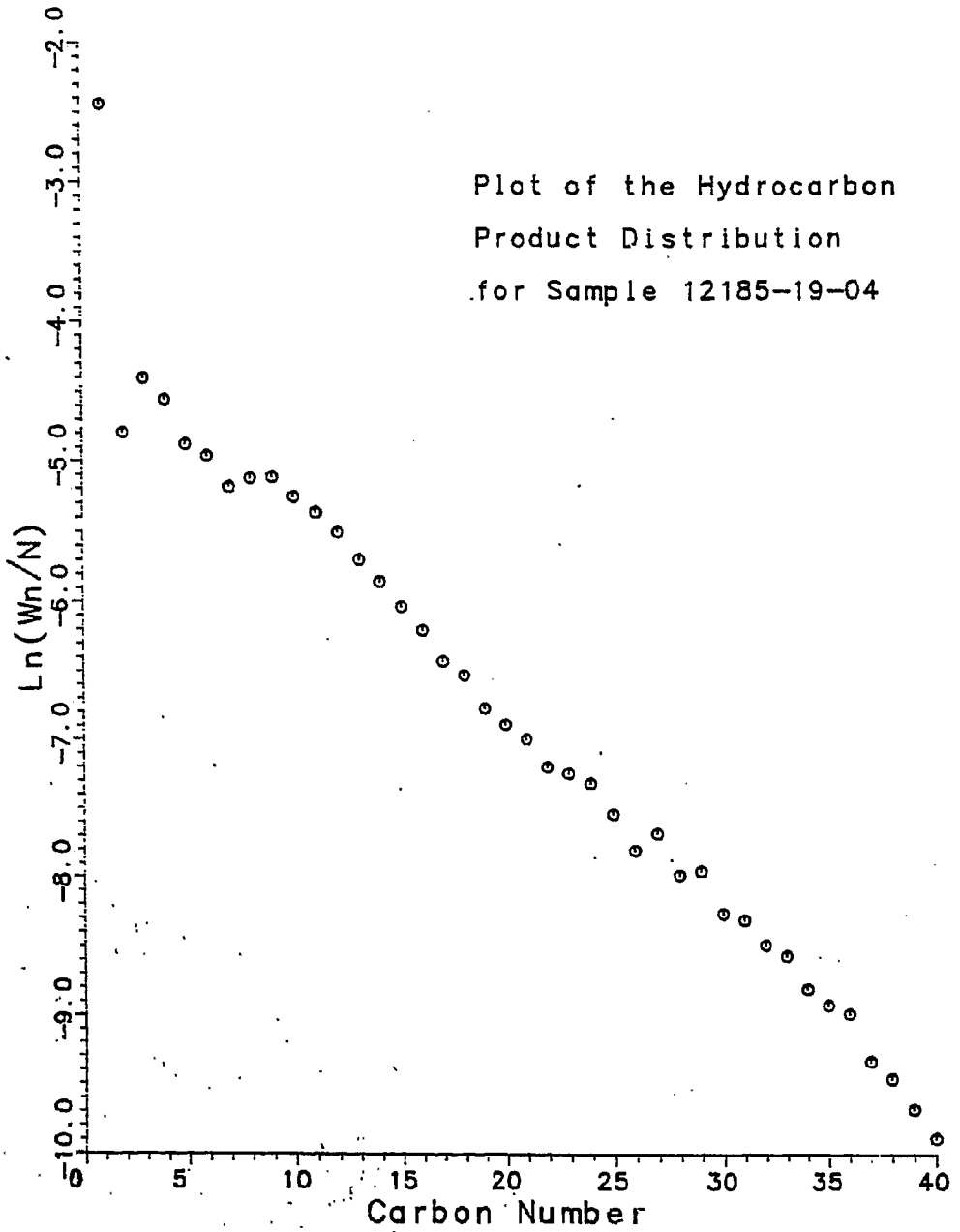

Plot of the Hydrocarbon
Product Distribution
for Sample 12185-19-04
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B125

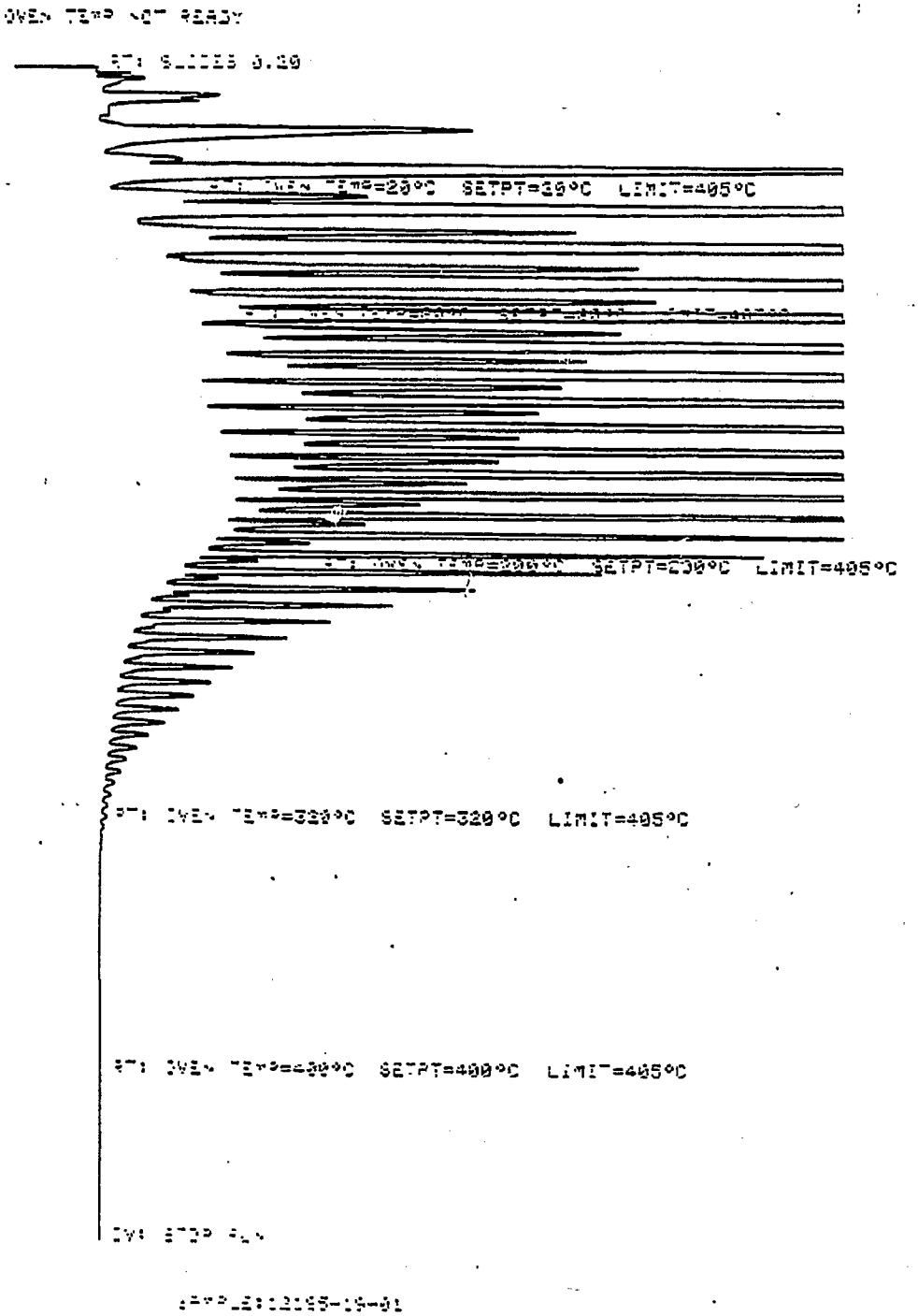

OVEN TEMP NOT READY
ET: 5.1115 0.00
ET: OVEN TEMP=20°C SETPT=30°C LIMIT=405°C
ET: OVEN TEMP=330°C SETPT=330°C LIMIT=405°C
ET: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B126

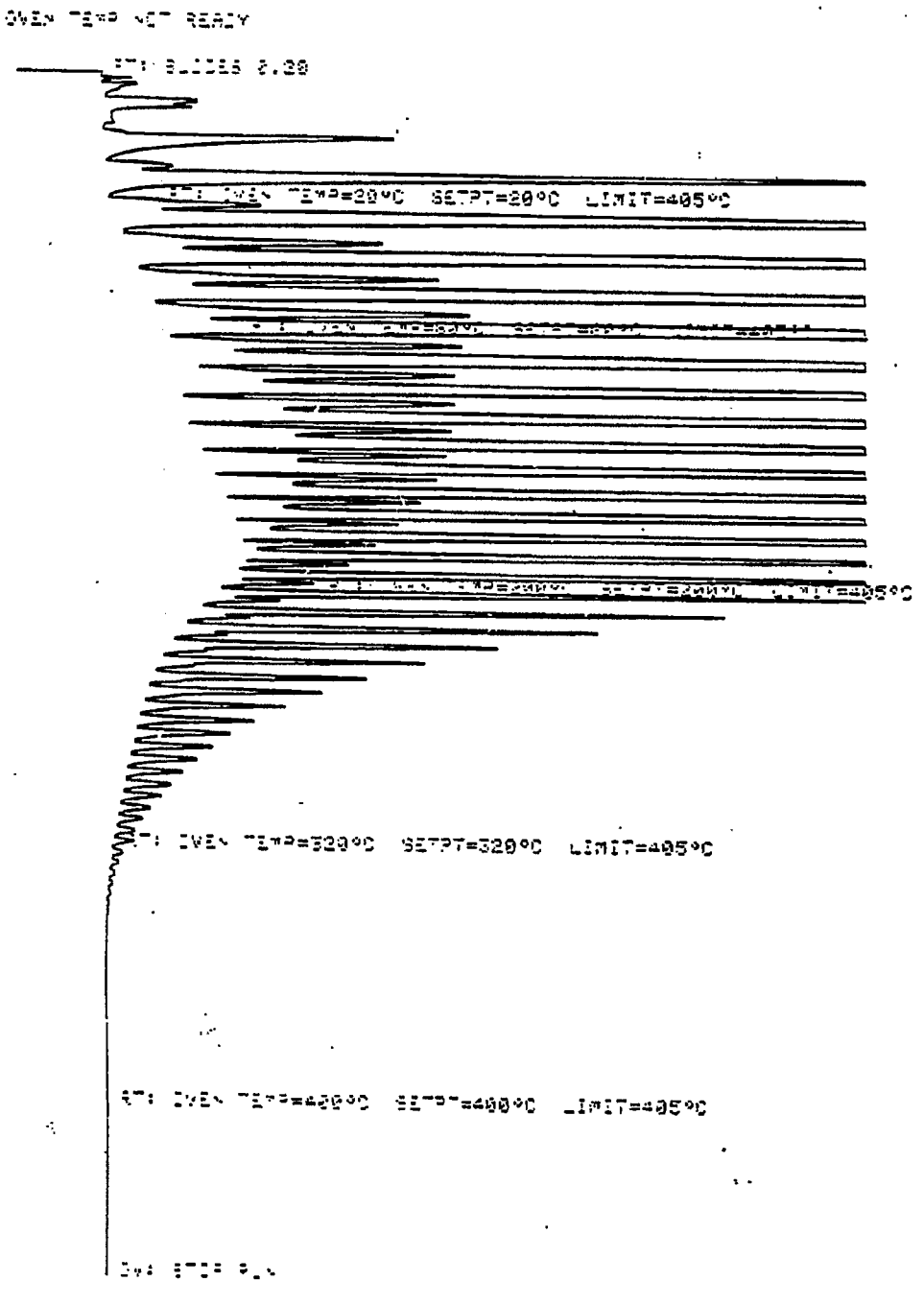

OVEN TEMP SET READY
OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B127

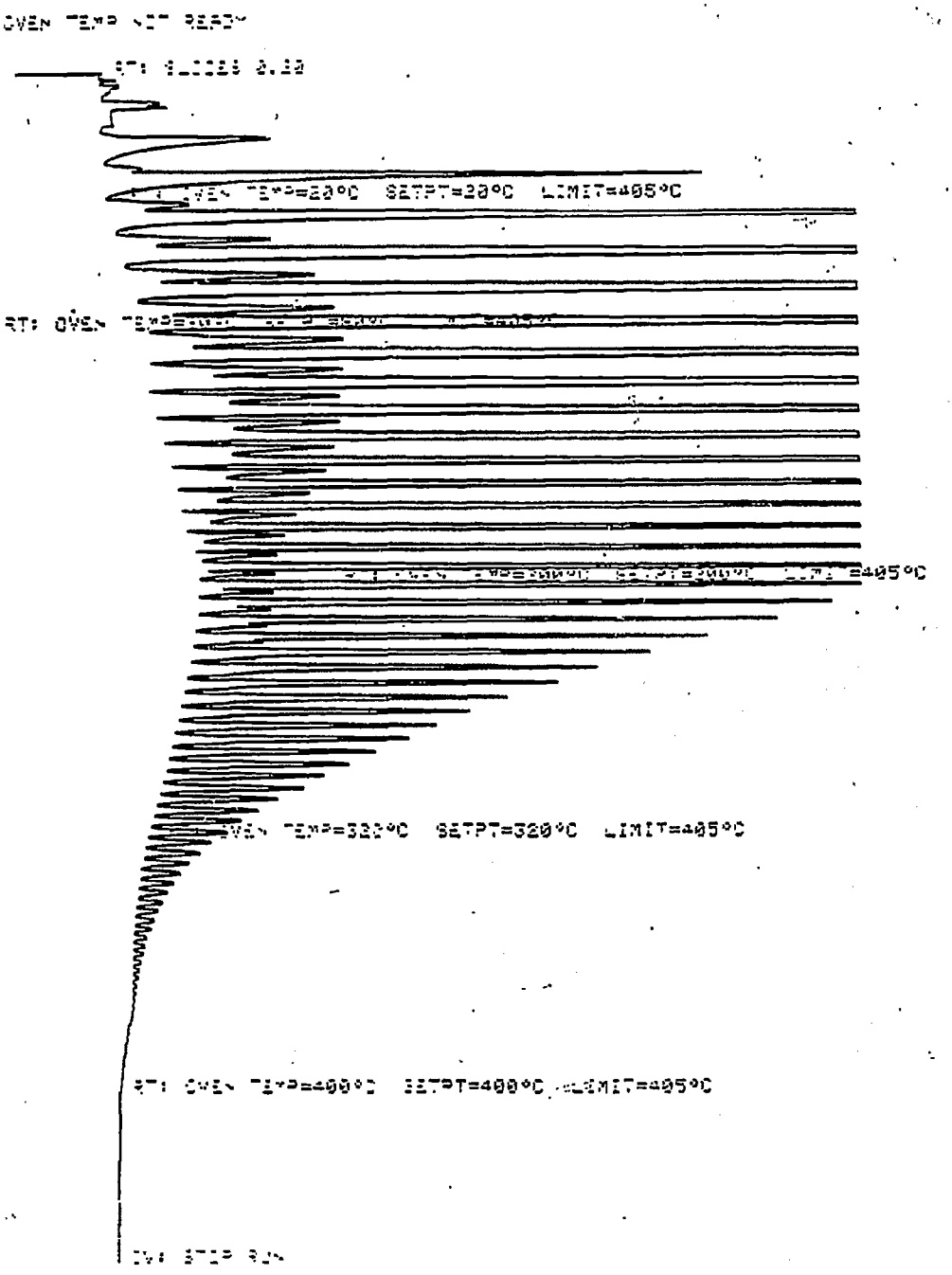


Fig. B128

Table B14

FILE: 1218519A TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 12185-19
CATALYST CO/X11/X3-U103 80 CC 35.2 G AFTER USE:49.8 G (+14.6 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV (CAT#12251-87-11)

RUN & SAMPLE NO.	12185-19-01	185-19-02	185-19-03	185-19-04	185-19-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	19.0	43.0	67.0	91.0	163.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	259	262	259	259	259
FEED CC/MIN	400	400	400	400	400
HOURS FEEDING	19.00	24.00	24.00	24.00	72.00
EFFLNT GAS LITER	117.30	232.35	268.85	269.85	862.40
GM AQUEOUS LAYER	58.96	73.16	60.37	61.81	181.44
GM OIL	25.27	32.61	41.70	44.25	114.29
MATERIAL BALANCE					
GM ATOM CARBON %	68.72	83.41	96.81	97.27	97.24
GM ATOM HYDROGEN %	74.20	96.12	99.22	101.94	102.37
GM ATOM OXYGEN %	82.85	92.28	94.26	93.71	94.98
RATIO CHX/(H2O+CO2)	0.6677	0.7848	1.0737	1.1028	1.0675
RATIO X IN CHX	2.2439	2.3637	2.3028	2.2928	2.3285
USAGE H2/CO PRODT	1.9320	1.9595	1.7454	1.7713	1.8401
FEED H2/CO FRM EFFLNT	1.0798	1.1524	1.0248	1.0480	1.0528
RESIDUAL H2/CO RATIO	0.1928	0.4839	0.4788	0.4971	0.5242
RATIO CO2/(H2O+CO2)	0.1566	0.1317	0.1320	0.1122	0.0981
K SHIFT IN EFFLNT	0.0358	0.0734	0.0728	0.0628	0.0570
SPECIFIC ACTIVITY SA	10.7252	1.9514	2.2035	2.0876	1.7366
CONVERSION					
ON CO %	51.00	45.30	43.11	43.24	40.17
ON H2 %	91.25	77.03	73.42	73.08	70.21
ON CO+H2 %	71.90	62.29	58.45	58.51	55.57
PRDT SELECTIVITY,WT %					
CH4	6.62	12.11	9.25	8.78	10.67
C2 HC'S	1.53	2.26	1.75	1.66	1.76
C3H8	1.35	2.79	2.01	1.82	2.11
C3H6=	2.81	1.89	2.08	1.88	2.24
C4H10	1.40	2.44	1.88	1.72	1.93
C4H8=	3.44	2.79	2.73	2.52	2.62
C5H12	1.80	2.73	2.16	2.04	2.40
C5H10=	2.77	1.83	1.92	1.79	2.12
C6H14	2.24	3.02	2.34	2.21	2.71
C6H12= & CYCLO'S	2.24	1.69	1.57	1.48	1.69
C7+ IN GAS	7.31	7.36	6.26	5.81	7.15
LIQ HC'S	66.47	59.08	66.05	68.29	62.59
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	17.16	24.29	19.70	18.38	21.34
C5 -420 F	50.27	41.74	37.50	37.36	38.10
420-700 F	29.32	28.71	27.74	28.68	26.29
700-END PT	3.26	5.26	15.06	15.57	14.27

Table B14 (continued)

FILE: 1218519A TSS4Q1 A1

C5+-END PT	82.84	75.71	80.30	81.62	78.66
ISO/NORMAL MOLE RATIO					
C4	0.0124	0.0163	0.0131	0.0145	0.0153
C5	0.0531	0.0601	0.0538	0.0497	0.0514
C6	0.0736	0.1146	0.0878	0.0836	0.0847
C4=	0.0000	0.0000	0.0000	0.0000	0.0000
PARAFFIN/OLEFIN RATIO					
C3	0.4589	1.4049	0.9257	0.9268	0.9015
C4	0.3934	0.8449	0.6649	0.6589	0.7125
C5	0.6304	1.4512	1.0925	1.1038	1.0991
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8094	0.8298	0.8630	0.8664	0.8588
RATIO CH4/(1-A)**2	1.8222	4.1783	4.9285	4.9227	5.3571
ALPHA FRM CORRELATION	0.8910	0.8460	0.8467	0.8449	0.8423
ALPHA (EXPTL/CORR)	0.9084	0.9808	1.0192	1.0255	1.0196
W%CH4 FRM CORRELATION	1.4033	15.9919	15.1517	15.7178	16.5209
W%CH4 (EXPTL/CORR)	4.7150	0.7572	0.6106	0.5588	0.6461
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLD OIL	CLD OIL	OIL WAX	OIL WAX	OIL WAX
DENSITY	N/A	N/A	N/A	N/A	N/A
N, REFRACTIVE INDEX	N/A	N/A	N/A	N/A	N/A
SIMULT'D DISTILATN					
10 WT % @ DEG F	250	260		292	
16	287	300		332	
50	417	453		508	
84	593	640		761	
90	638	685		830	
RANGE(16-84 %)	306	340		429	
WT % @ 420 F	51.00	42.50		33.20	
WT % @ 700 F	95.10	91.10		77.20	

Table B15

FILE: 1218519B TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 12185-19
CATALYST CO/X11/X3-U103 80 CC 35.2 G AFTER USE:49.8 G (+14.6 G)
FEED H2:CO OF 50:50 @ 400 CC/MN OR 300 GHSV (CAT#12251-87-11)

RUN & SAMPLE NO.	12185-19-06
FEED H2:CO:AR	50:50: 0
HRS ON STREAM	187.0
PRESSURE,PSIG	300
TEMP. C	260
FEED CC/MIN	400
HOURS FEEDING	24.00
EFFLNT GAS LITER	290.50
GM AQUEOUS LAYER	57.74
GM OIL	43.78
MATERIAL BALANCE	
GM ATOM CARBON %	101.37
GM ATOM HYDROGEN %	105.09
GM ATOM OXYGEN %	94.40
RATIO CHX/(H2O+CO2)	1.2161
RATIO X IN CHX	2.3161
USAGE H2/CO PRODT	1.7498
FEED H2/CO FRM EFFLNT	1.0367
RESIDUAL H2/CO RATIO	0.5218
RATIO CO2/(H2O+CO2)	0.1019
K SHIFT IN EFFLNT	0.0592
SPECIFIC ACTIVITY SA	1.7683
CONVERSION	
ON CO %	41.93
ON H2 %	70.77
ON CO+H2 %	56.61
PRDT SELECTIVITY,WT %	
CH4	9.99
C2 HC'S	1.86
C3H8	1.95
C3H6=	2.05
C4H10	1.85
C4H8=	2.61
C5H12	2.22
C5H10=	1.82
C6H14	2.32
C6H12= & CYCLO'S	1.42
C7+ IN GAS	6.24
LIQ HC'S	65.66
TOTAL	100.00
SUB-GROUPING	
C1 -C4	20.31
C5 -420 F	37.14
420-700 F	27.58
700-END PT	14.97

Table B15 (continued)

FILE: 1218519B TSS4Q1 A1

C5+-END PT	79.69
ISO/NORMAL MOLE RATIO	
C4	0.0142
C5	0.0640
C6	0.0821
C4=	0.0000
PARAFFIN/OLEFIN RATIO	
C3	0.9097
C4	0.6854
C5	1.1851
SCHULZ-FLORY DISTRBTN	
ALPHA (EXP(SLOPE))	0.8636
RATIO CH4/(1-A)**2	5.3734
ALPHA FRM CORRELATION	0.8425
ALPHA (EXPTL/CORR)	1.0251
W%CH4 FRM CORRELATION	16.6788
W%CH4 (EXPTL/CORR)	0.5990
LIQ HC COLLECTION	
PHYS. APPEARANCE	OIL WAX
DENSITY	N/A
N, REFRACTIVE INDEX	N/A
SIMULT'D DISTILATN	
10 WT % @ DEG F	
16	
50	
84	
90	
RANGE(16-84 %)	
WT % @ 420 F	
WT % @ 700 F	

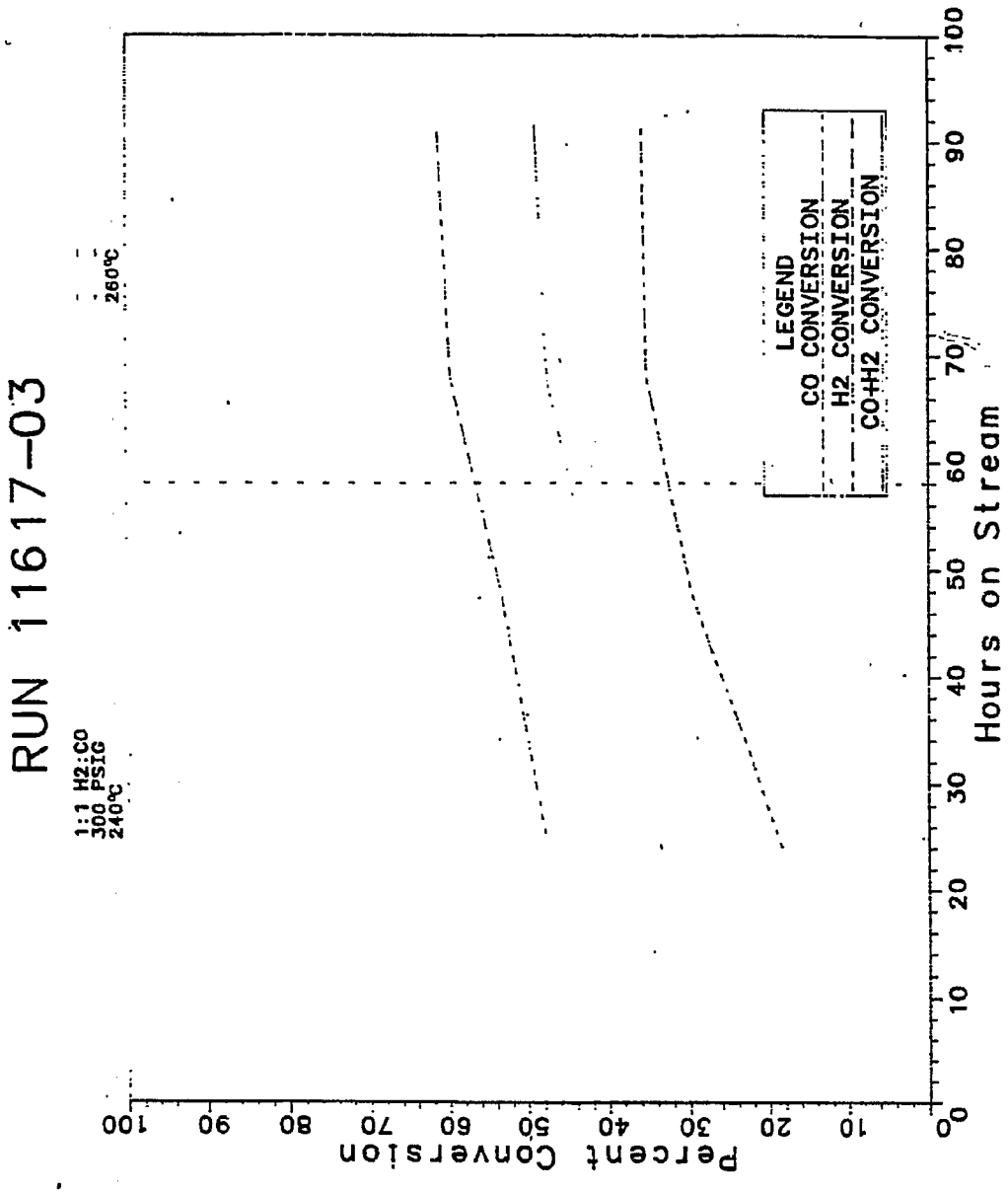

RUN 11617-03
1:1 H2:CO
300 PSIG
240°C
260°C
LEGEND
CO CONVERSION
H2 CONVERSION
CO+H2 CONVERSION
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100

Fig. B129

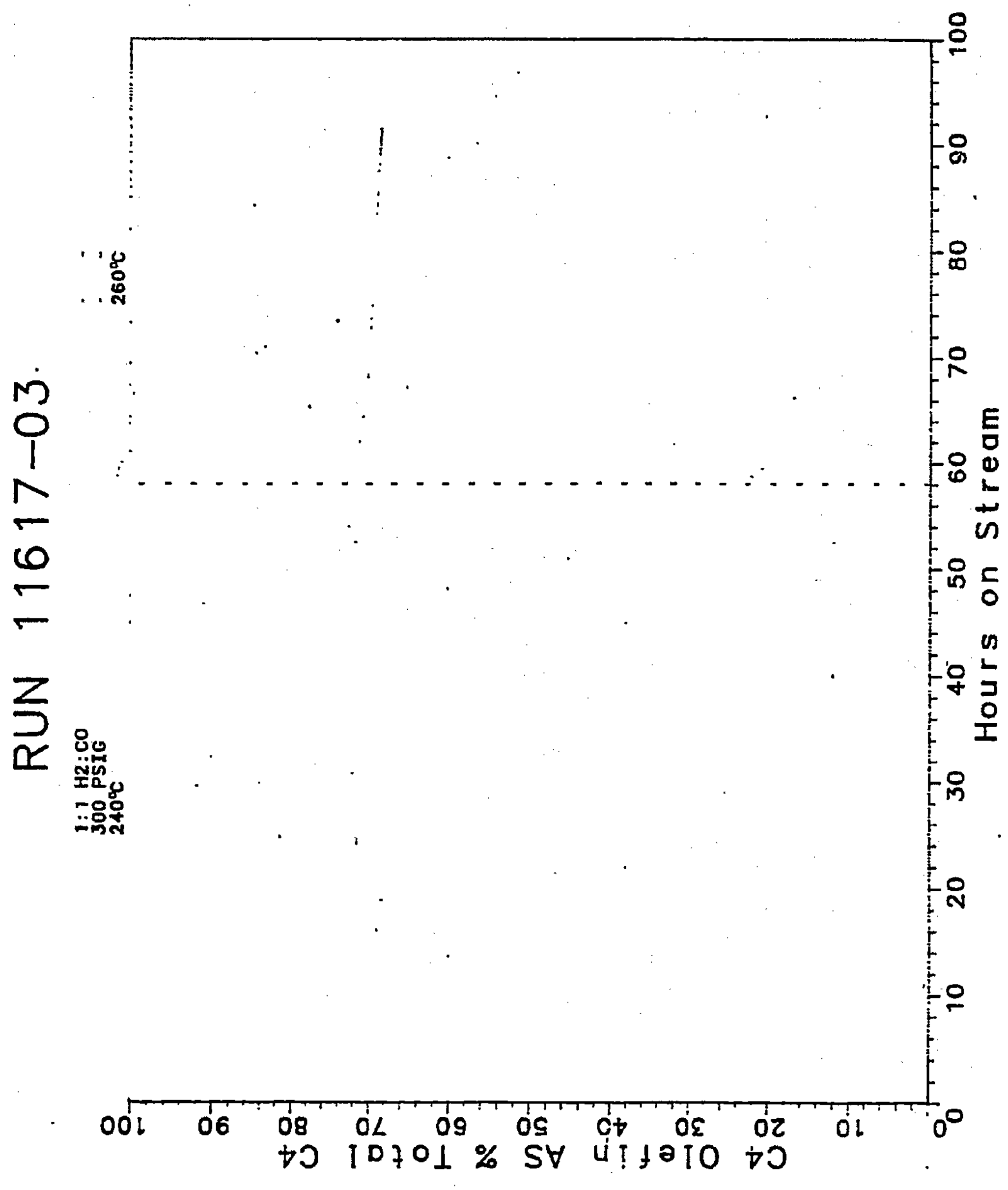

RUN 11617-03
1:1 H2:CO
300 PSIG
240°C
260°C
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
C4 Olefin AS % Total C4

Fig. B130

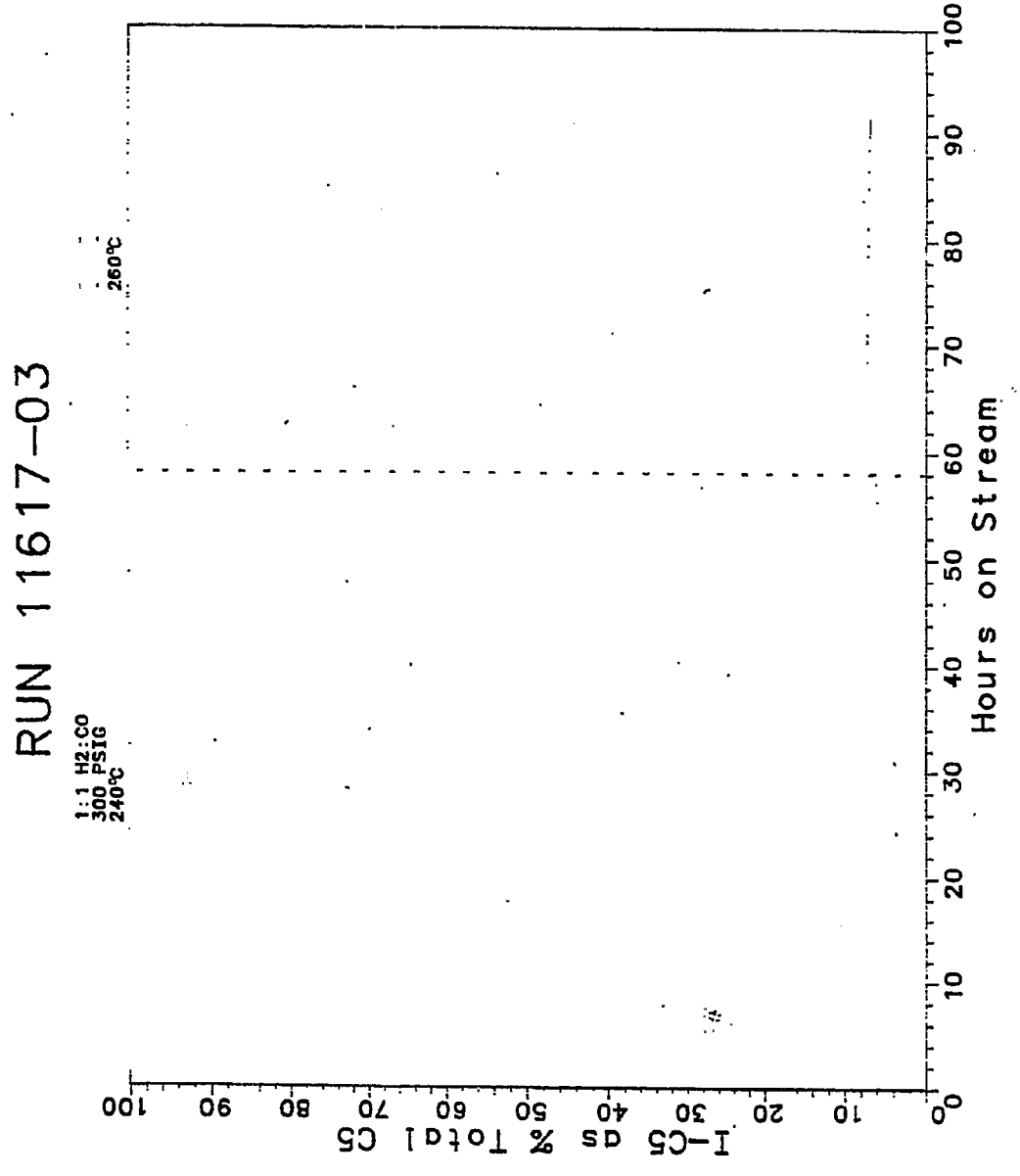

RUN 11617-03
1:1 H2:CO
300 PSIG
240°C
260°C
I-C5 as % Total C5
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100

Fig. B131

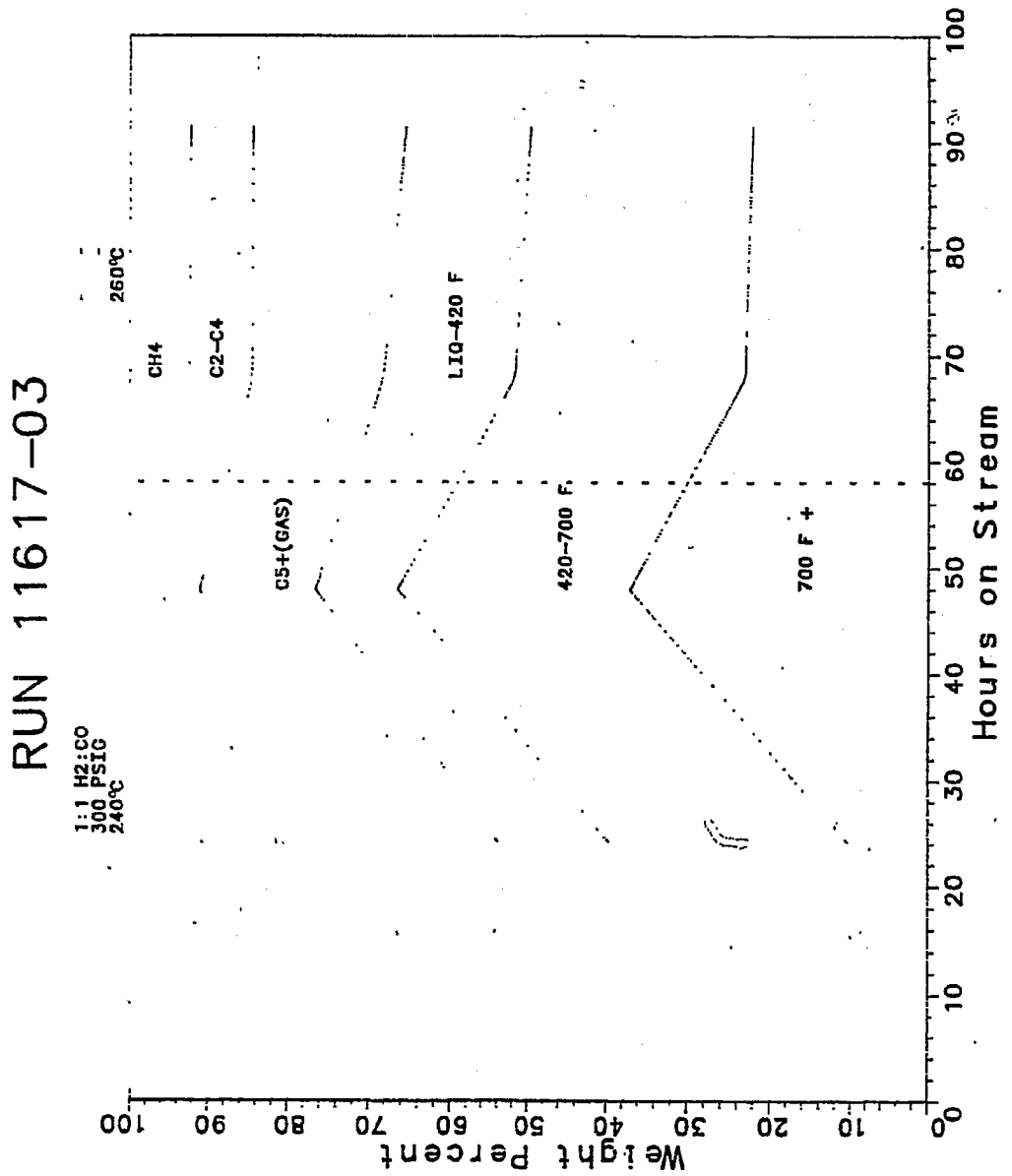

RUN 11617-03
1:1 H2:CO
300 PSIG
240°C
260°C
CH4
C2-C4
C5+(GAS)
LIQ-420 F
420-700 F.
700 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100

Fig. B132

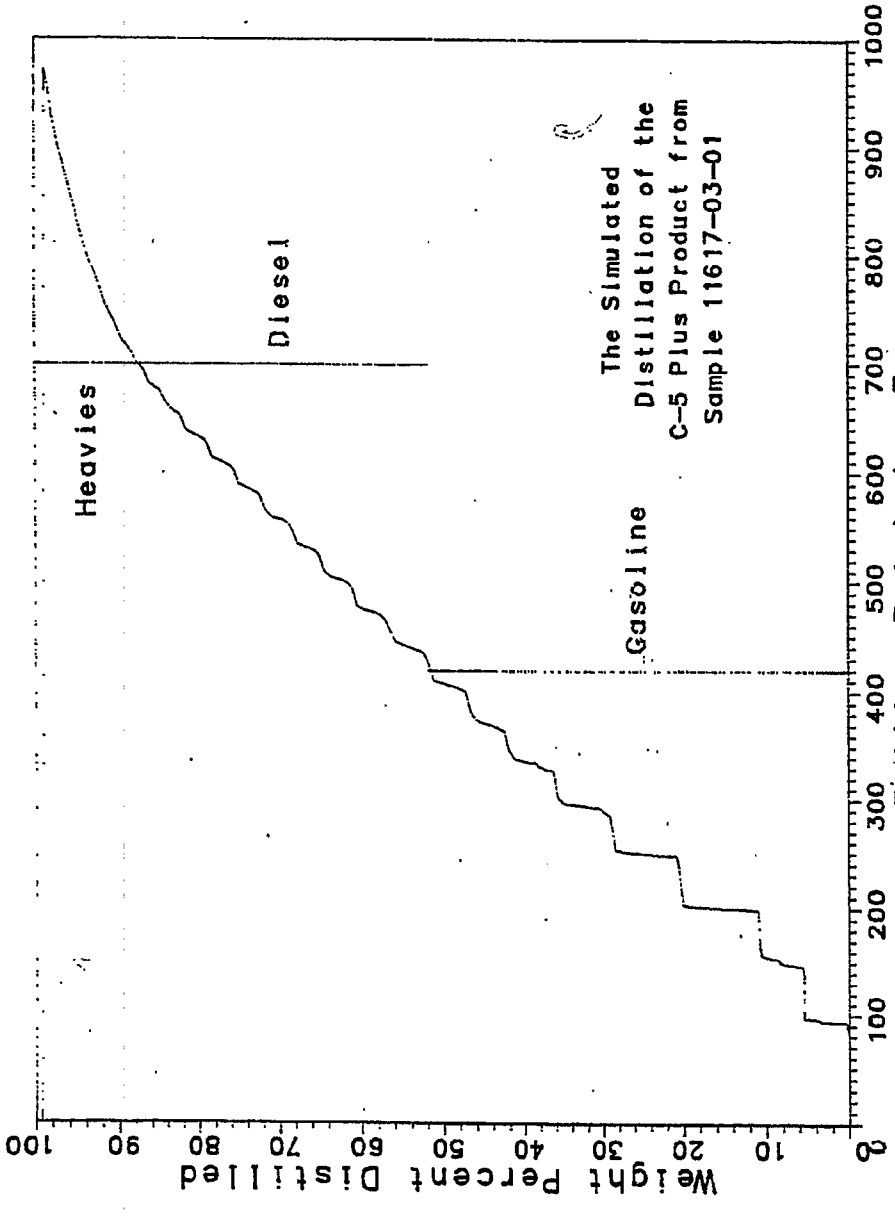

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-03-01
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B133

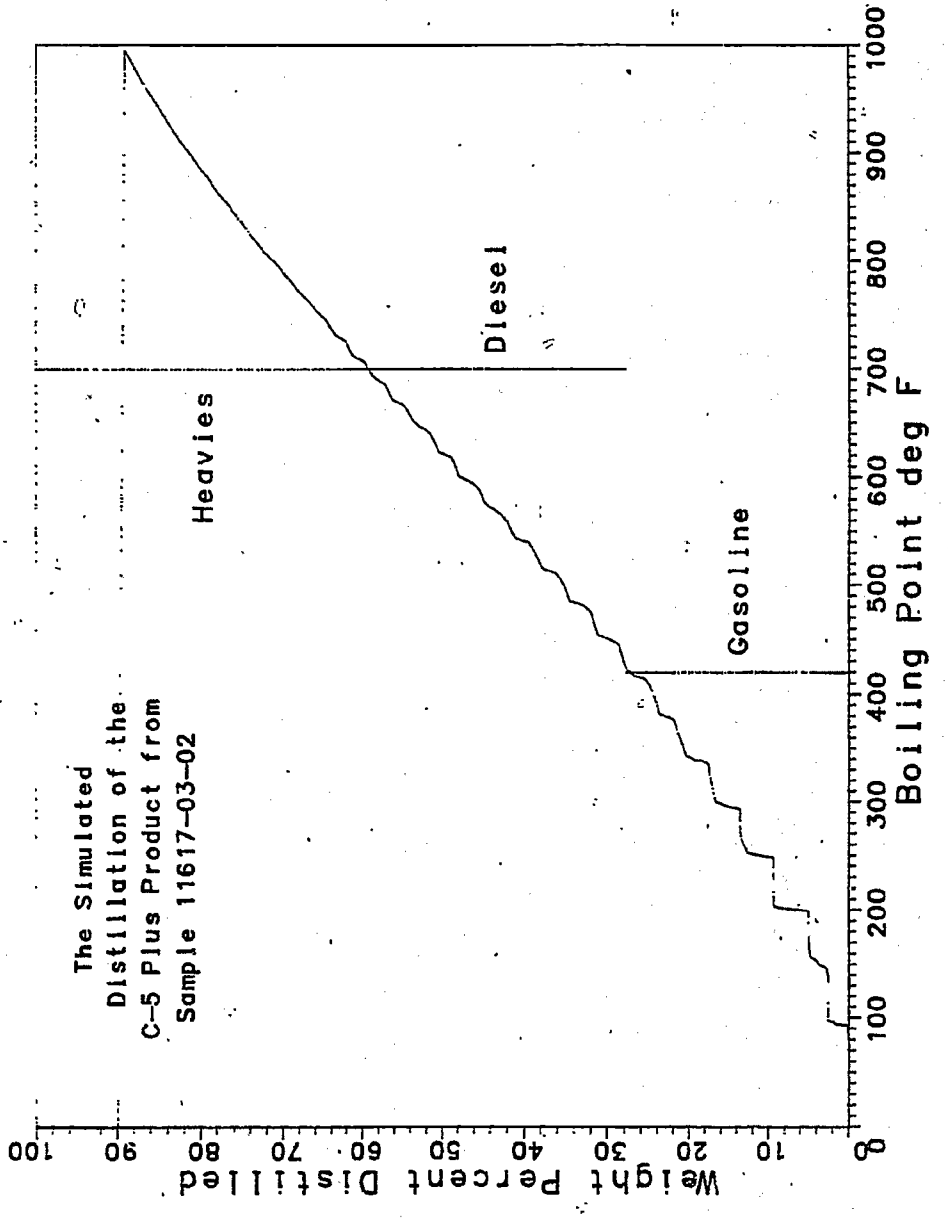

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-03-02
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B134

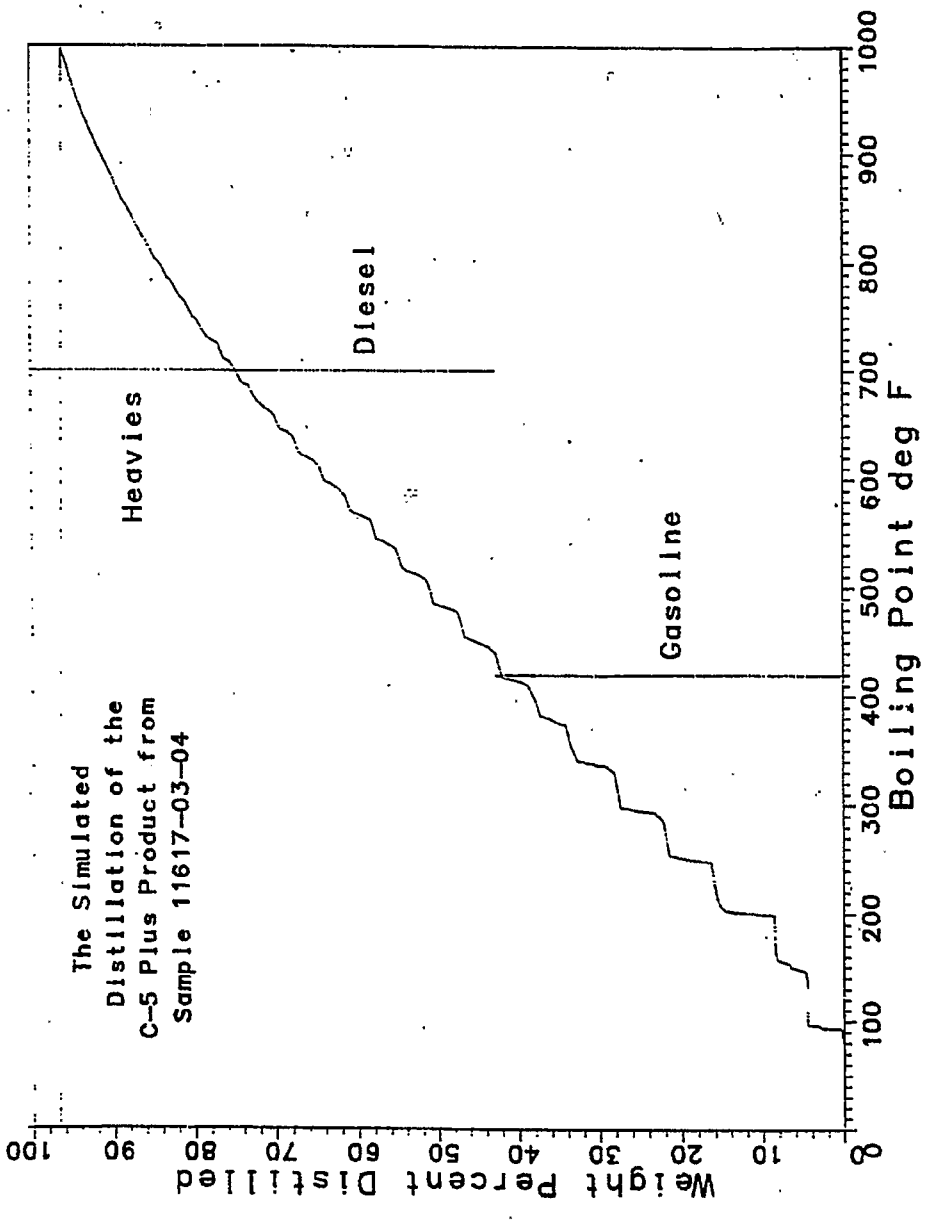

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-03-04
Heavies
Diesel
Gasoline
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point deg F
100
200
300
400
500
600
700
800
900
1000

Fig. B135

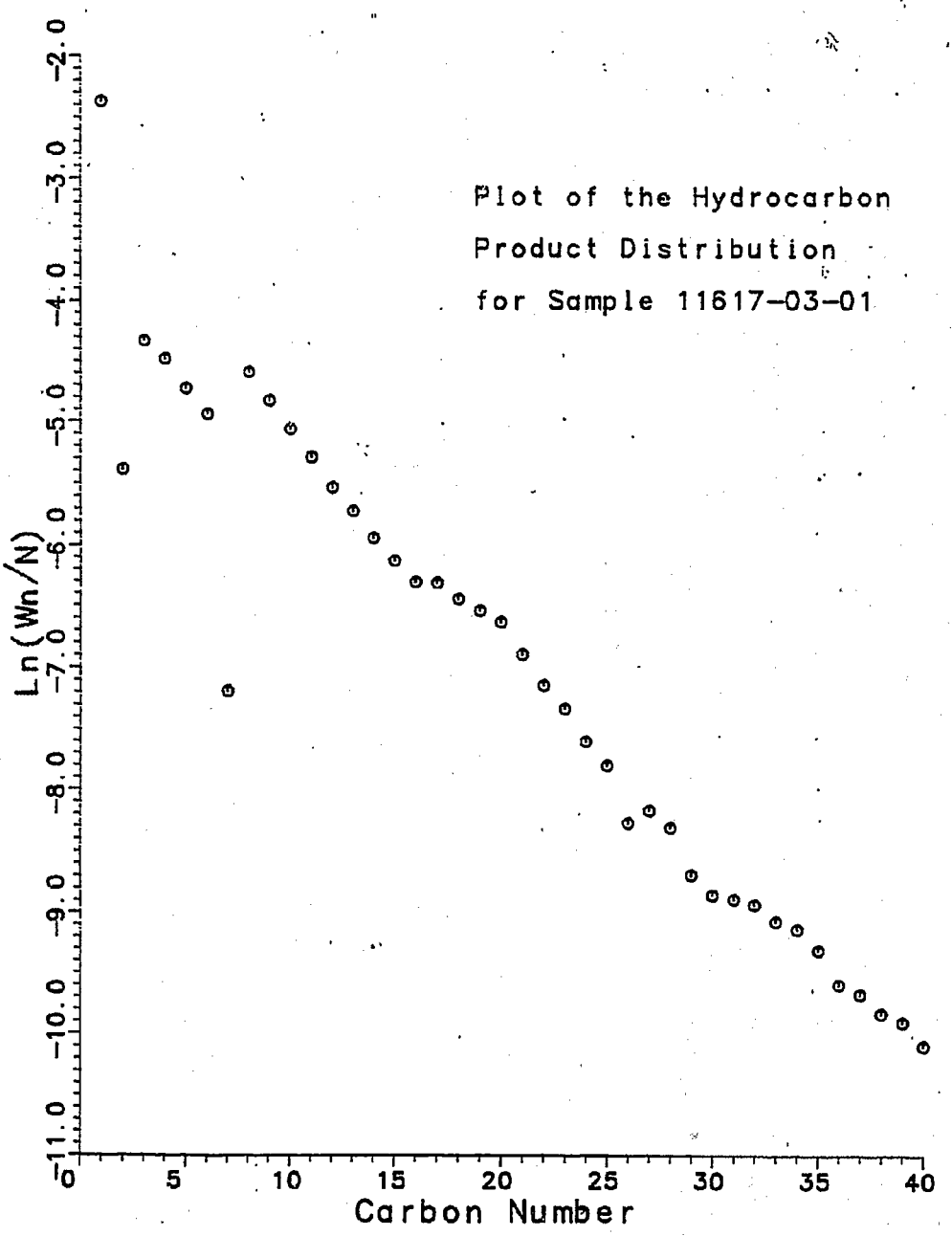

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-03-01
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B136

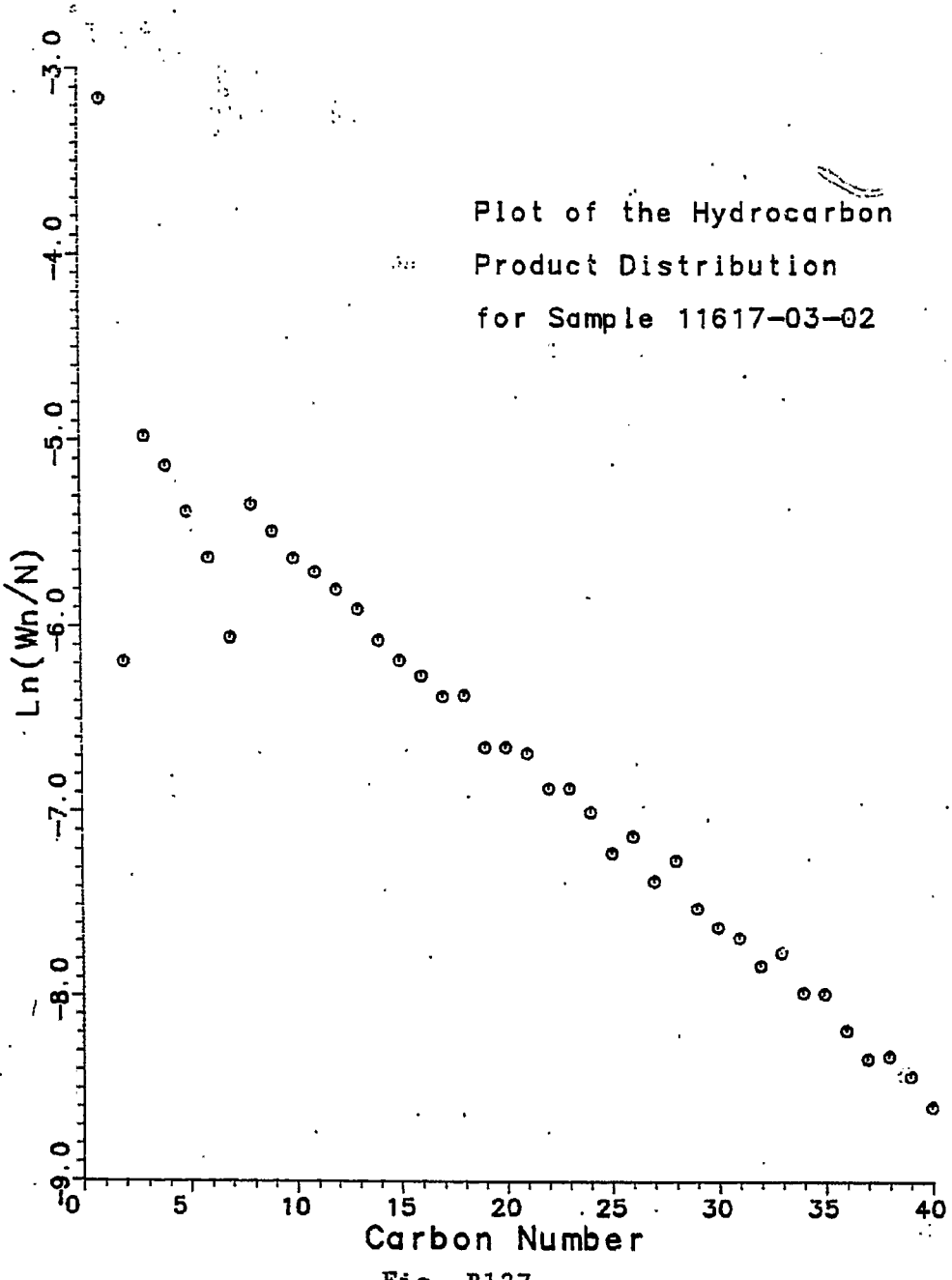

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-03-02
Ln(Wn/N)
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B137

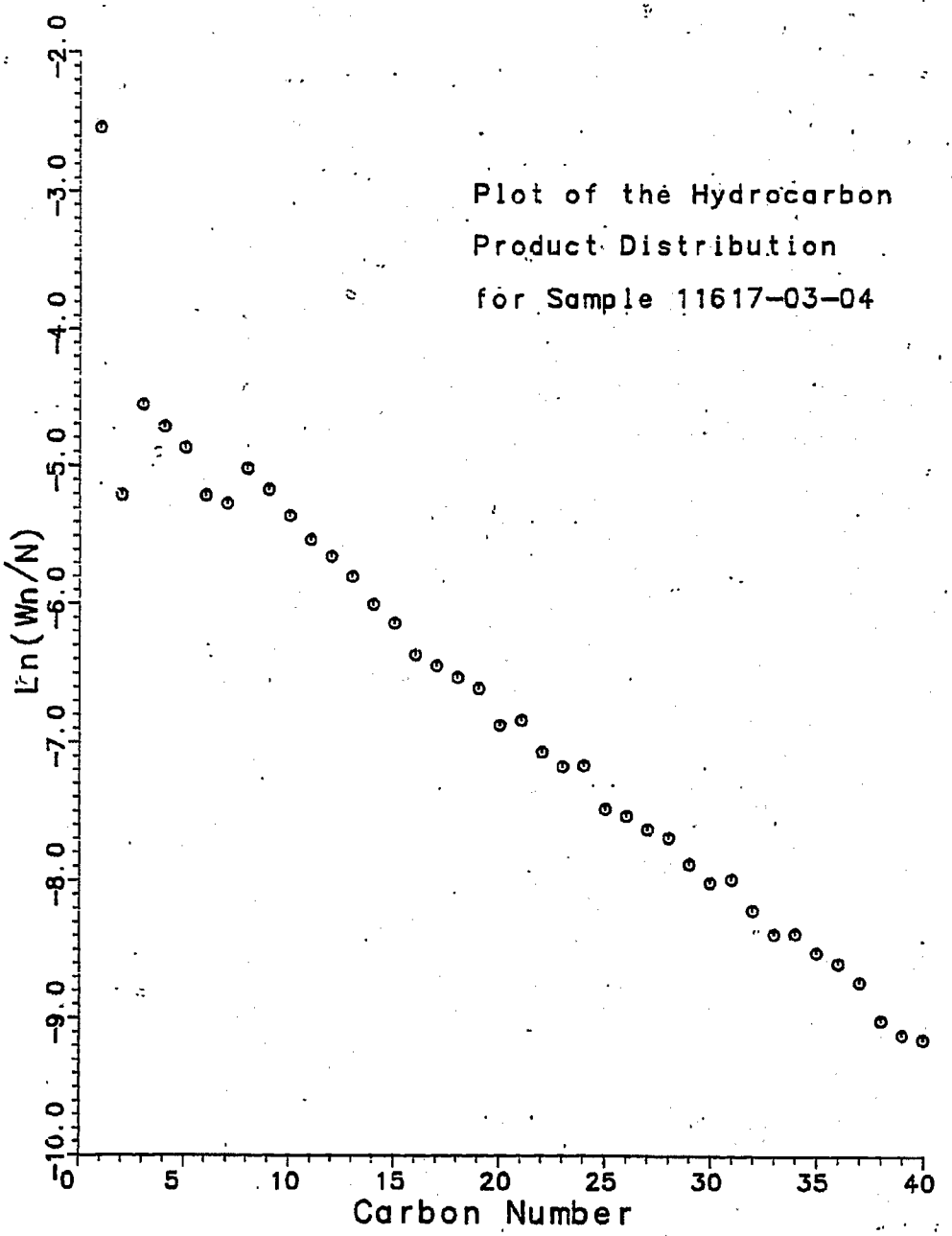
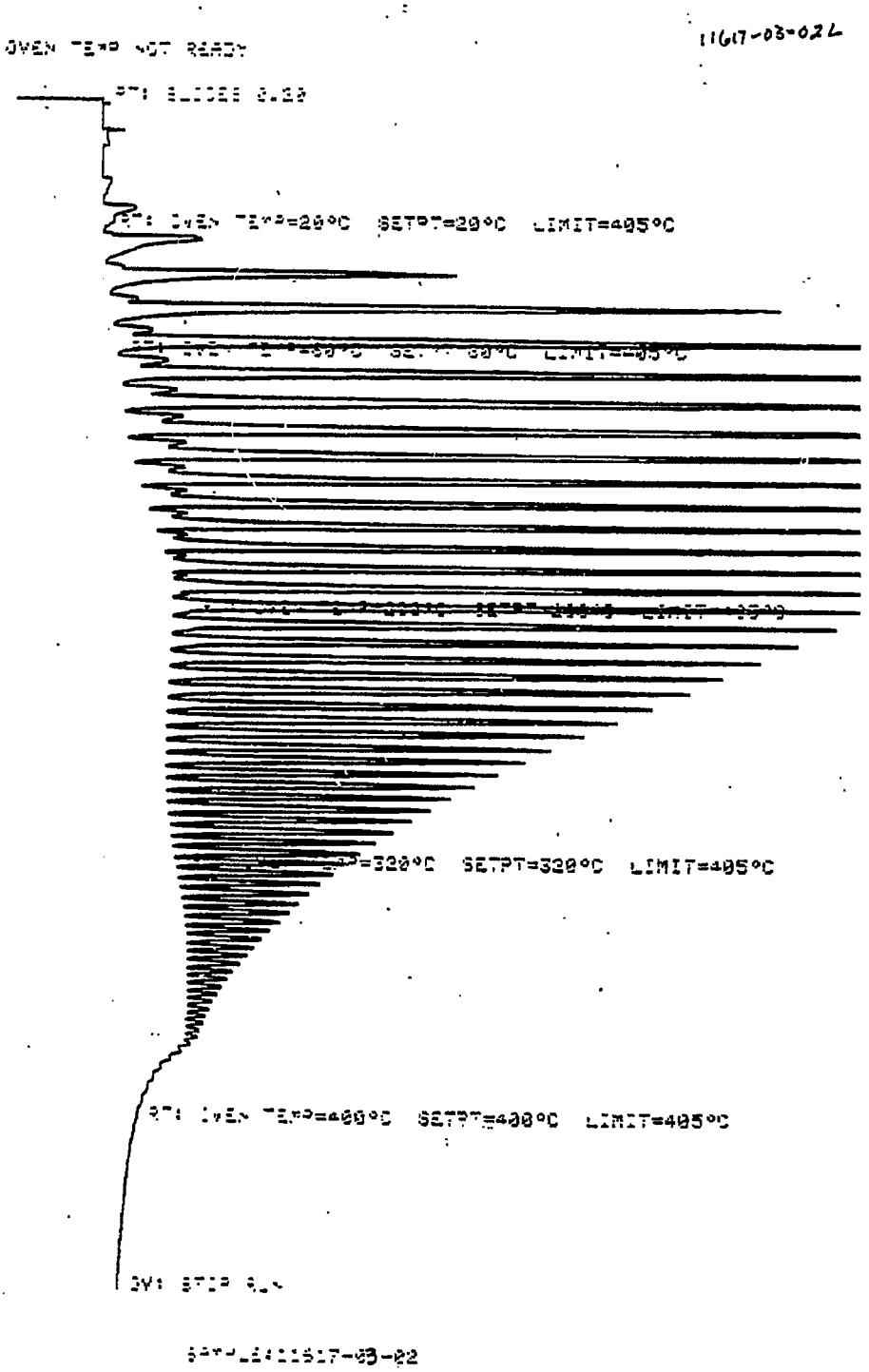

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-03-04
Ln (Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B138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11617-03-02L
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SET: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
SET: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B139

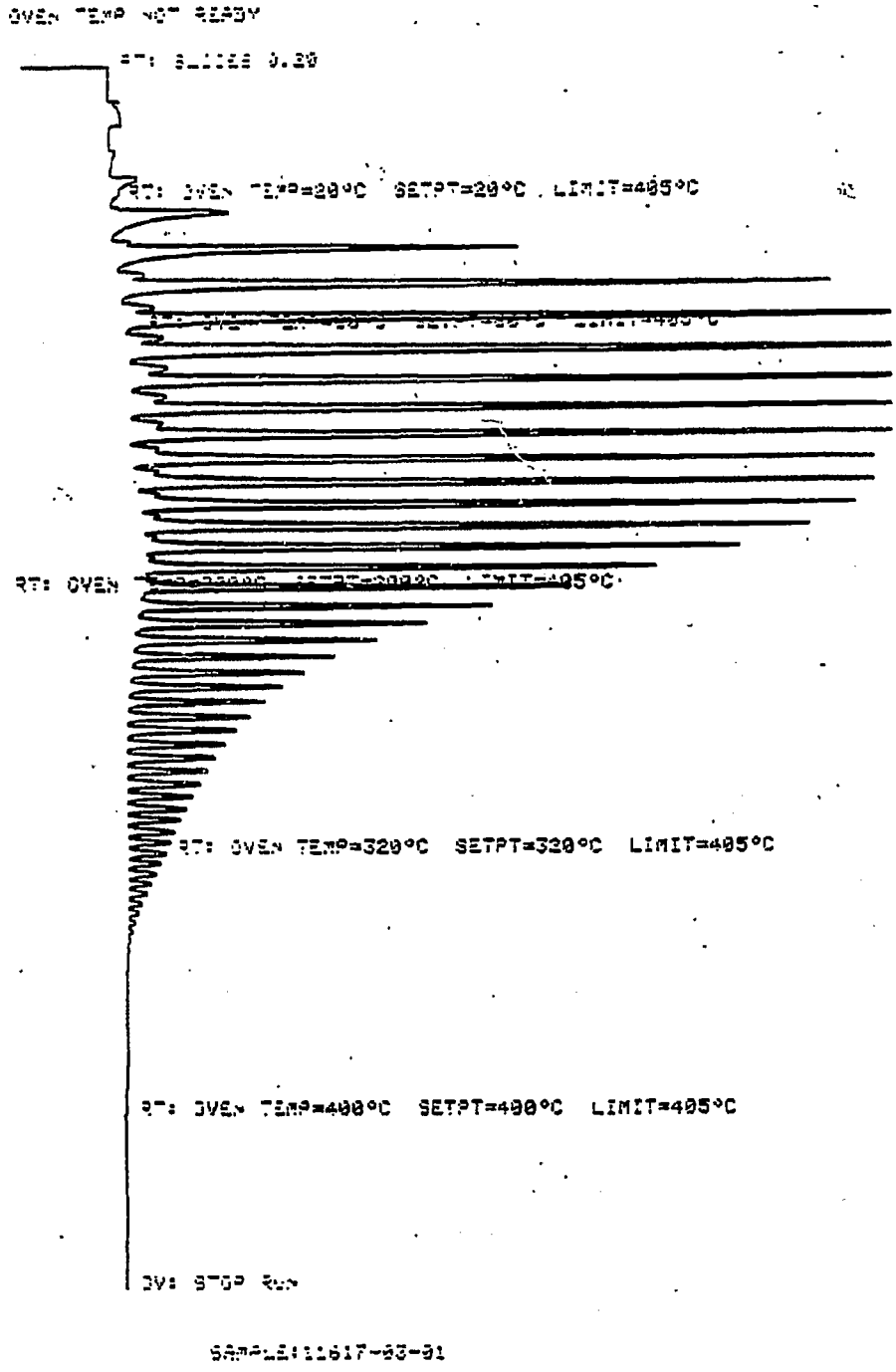

78T
OVEN TEMP NOT READY
RT: OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
RT: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C
OV: STOP RUN
SAMPLE:11617-03-01

Fig. B140

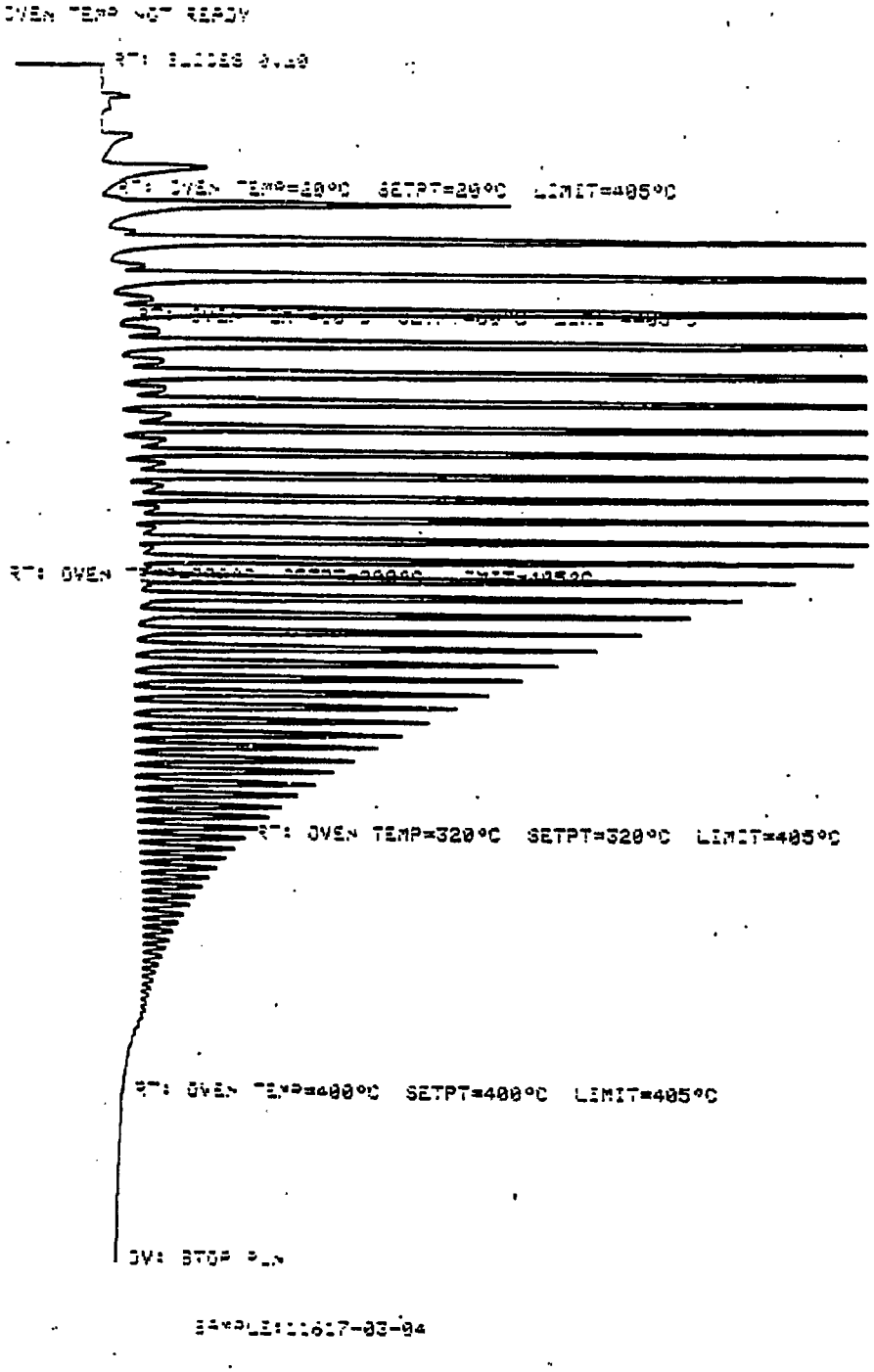

OVEN TEMP NOT READY
RT: OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
RT: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C
OV: STOP

Fig. B141

Table B16

FILE: 1161703A TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-03
CATALYST CO/X11-U103 250 CC 129.7 G AFTER USE:171.4 G (+41.7 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV (CAT#12251-96)

RUN & SAMPLE NO.	11617-03-01	617-03-02	617-03-03	617-03-04
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	24.0	48.0	68.0	91.5
PRESSURE,PSIG	300	300	300	300
TEMP. C	242	242	259	259
FEED CC/MIN	1260	1260	1260	1260
HOURS FEEDING	24.00	24.00	20.00	23.50
EFFLNT GAS LITER	1123.50	1047.00	836.00	882.13
GM AQUEOUS LAYER	167.68	132.81	118.20	145.17
GM OIL	41.39	108.03	93.61	98.35
MATERIAL BALANCE				
GM ATOM CARBON %	84.90	92.84	96.28	86.98
GM ATOM HYDROGEN %	92.04	95.70	97.06	91.69
GM ATOM OXYGEN %	98.92	89.12	91.58	84.50
RATIO CHX/(H2O+CO2)	0.5074	1.1621	1.1793	1.0940
RATIO X IN CHX	2.2694	2.1873	2.2549	2.2557
USAGE H2/CO PRODT	2.7946	1.8489	1.7102	1.8077
FEED H2/CO FRM EFFLNT	1.0841	1.0309	1.0081	1.0542
RESIDUAL H2/CO RATIO	0.6981	0.6843	0.6258	0.6323
RATIO CO2/(H2O+CO2)	0.0416	0.0429	0.1154	0.0913
K SHIFT IN EFFLNT	0.0303	0.0307	0.0816	0.0635
SPECIFIC ACTIVITY SA	0.9761	1.7688	0.9978	0.9772
CONVERSION				
ON CO %	18.41	29.76	35.25	35.89
ON H2 %	47.46	53.37	59.81	61.54
ON CO+H2 %	33.52	41.74	47.58	49.06
PRDT SELECTIVITY,WT %				
CH4	9.36	4.26	7.74	7.91
C2 HC'S	0.92	0.41	1.04	1.10
C3H8	1.15	0.54	1.12	1.16
C3H6=	2.81	1.53	2.11	1.99
C4H10	1.33	0.64	1.11	1.15
C4H8=	3.21	1.72	2.53	2.42
C5H12	1.63	0.76	1.30	1.39
C5H10=	2.80	1.56	2.08	2.46
C6H14	1.87	0.95	1.48	1.52
C6H12= & CYCLO'S	2.43	1.22	1.65	1.76
C7+ IN GAS	18.82	10.01	9.70	11.76
LIQ HC'S	53.68	76.41	68.14	65.37
TOTAL	100.00	100.00	100.00	100.00
SUB-GROUPING				
C1 -C4	18.77	9.10	15.65	15.74
C5 -420 F	41.81	24.65	32.60	34.61
420-700 F	29.28	29.19	28.66	27.50
700-END PT	10.15	37.06	23.09	22.16

Table B16 (continued)

FILE: 1161703A TSS4Q1 A1

C5+-END PT	81.23	90.90	84.35	84.26
ISO/NORMAL MOLE RATIO				
C4	0.0000	0.0000	0.0251	0.0183
C5	0.0378	0.0539	0.0785	0.0729
C6	0.0365	0.1018	0.1208	0.0926
C6=	0.0000	0.0000	0.0000	0.0000
PARAFFIN/OLEFIN RATIO				
C3	0.3907	0.3388	0.5062	0.5527
C4	0.3992	0.3583	0.4256	0.4600
C5	0.5655	0.4725	0.6062	0.5500
SCHULZ-FLORY DISTRBTN				
ALPHA (EXP(SLOPE))	0.8511	0.9129	0.7806	0.8802
RATIO CH4/(1-A)**2	4.2222	5.6145	1.6069	5.5124
ALPHA FRM CORRELATION	0.8293	0.8303		0.8332
ALPHA (EXPTL/CORR)	1.0263	1.0994		1.0564
W%CH4 FRM CORRELATION	16.8411	16.5401		19.3549
W%CH4 (EXPTL/CORR)	0.5555	0.2578		0.4089
LIQ HC COLLECTION				
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY				
N, REFRACTIVE INDEX				
SIMULT'D DISTILATN				
10 WT % @ DEG F	333	401		337
16	372	450		379
50	534	689		592
84	722	961		856
90	795	1034		930
RANGE(16-84 %)	350	511		477
WT % @ 420 F	26.56	13.30	24.05	24.05
WT % @ 700 F	81.10	51.50	66.11	66.11

IX. Run 42 (11617-05) with Catalyst 42 (Co/X_{11}/TC-103)

The purpose of this run was to test a variation of Catalyst 32 containing an elevated concentration of the promoter X_{11}. Preparation of the catalyst was similar to that of Catalyst 27. The concentrations of cobalt and X_{11} were 8.1 and 2.6 percent respectively; corresponding concentrations in Catalyst 32 were 8.2 and 1.6 percent.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B142-145. Simulated distillations of the C_5^+ product are plotted in Figs. B146-152. Carbon number product distributions are plotted in Figs. B153-159. Chromatograms from simulated distillations are reproduced in Figs. B160-166. Detailed material balances appear in Tables B17-19.

The test was run at 240C during the first 210 hours, followed by 120 hours at 260C. In the first stage, at 240C, the conversion of syngas was about 46 percent initially (after a good material balance was obtained), and declined gradually to about 41 percent. Methane production, about 7 percent initially, ranged from 5 to 6 percent during the rest of this stage. These levels closely parallel those of Catalyst 32 at the same temperature.

At 260C the activity increased sharply to nearly 57 percent conversion, and declined to 56 percent at the end of the run 48

hours later. Methane production, however, also rose sharply to more than 11 percent. Corresponding values for Catalyst 32 at 260C were: conversion about 57 percent, methane content 8.0 to 8.6 percent. At 260C, therefore, this catalyst appeared comparable to Catalyst 32 in activity, but inferior in selectivity and stability.

The hydrogenation ability of this catalyst, while similar to that of Catalyst 32 at 240C, was higher at 260C, as evidenced by the lower olefin content of the light gas fraction.

In this test the higher concentration of X_{11} had little or no effect at 240C, and impaired the catalyst's selectivity at 260C.

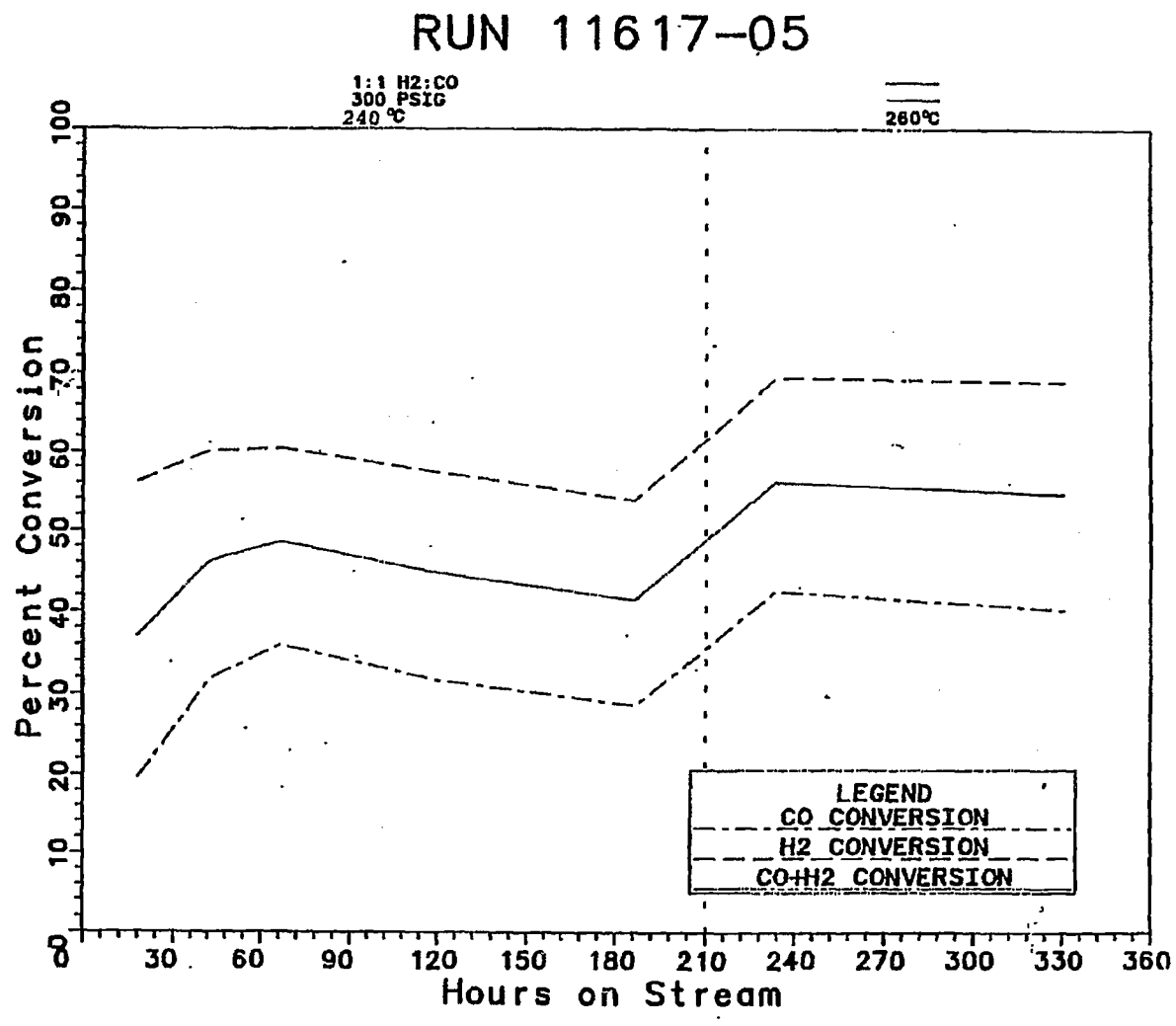

RUN 11617-05
1:1 H2:CO
300 PSIG
240 °C
260°C
Percent Conversion
0
10
20
30
40
50
60
70
80
90
100
30
60
90
120
150
180
210
240
270
300
330
360
Hours on Stream
LEGEND
CO CONVERSION
H2 CONVERSION
CO+H2 CONVERSION

Fig. B142

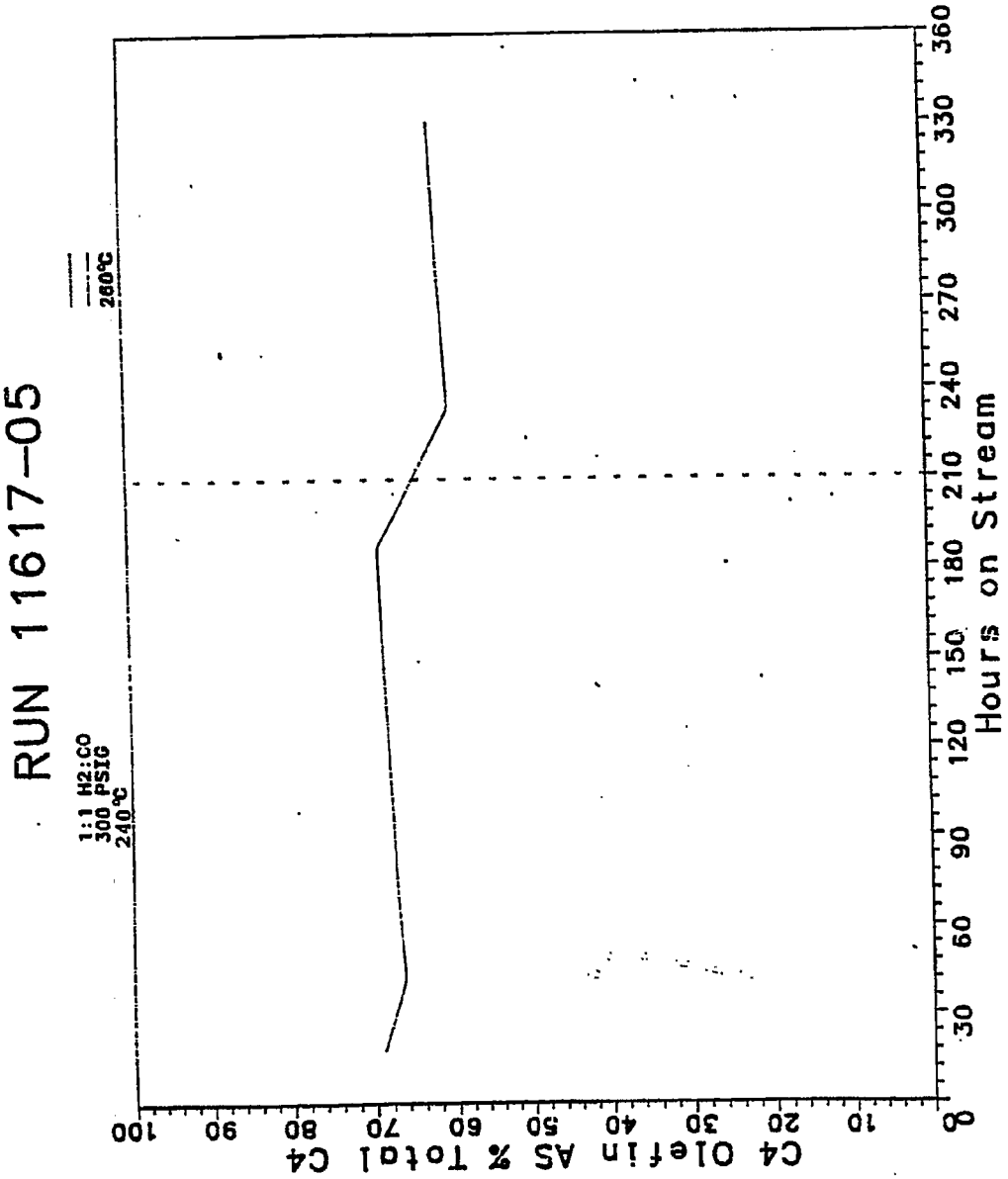

RUN 11617-05
1:1 H2:CO
300 PSIG
240°C
260°C
C4 Olefin AS % Total C4
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
30
60
90
120
150
180
210
240
270
300
330
360

Fig. B143

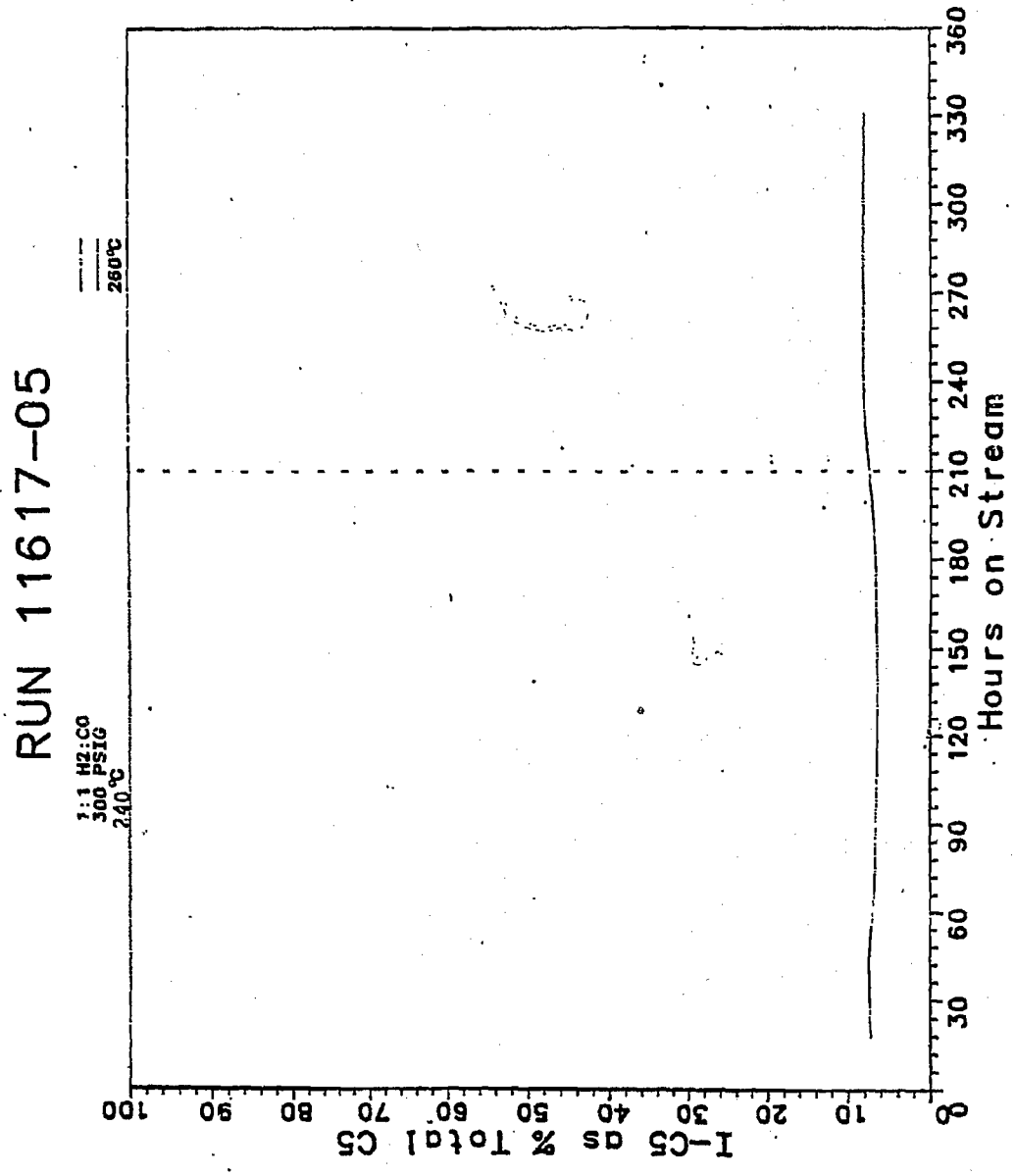

RUN 11617-05
1:1 H2:CO
300 PSIG
240 °C
260°C
I-C5 as % Total C5
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
30
60
90
120
150
180
210
240
270
300
330
360

Fig. B144

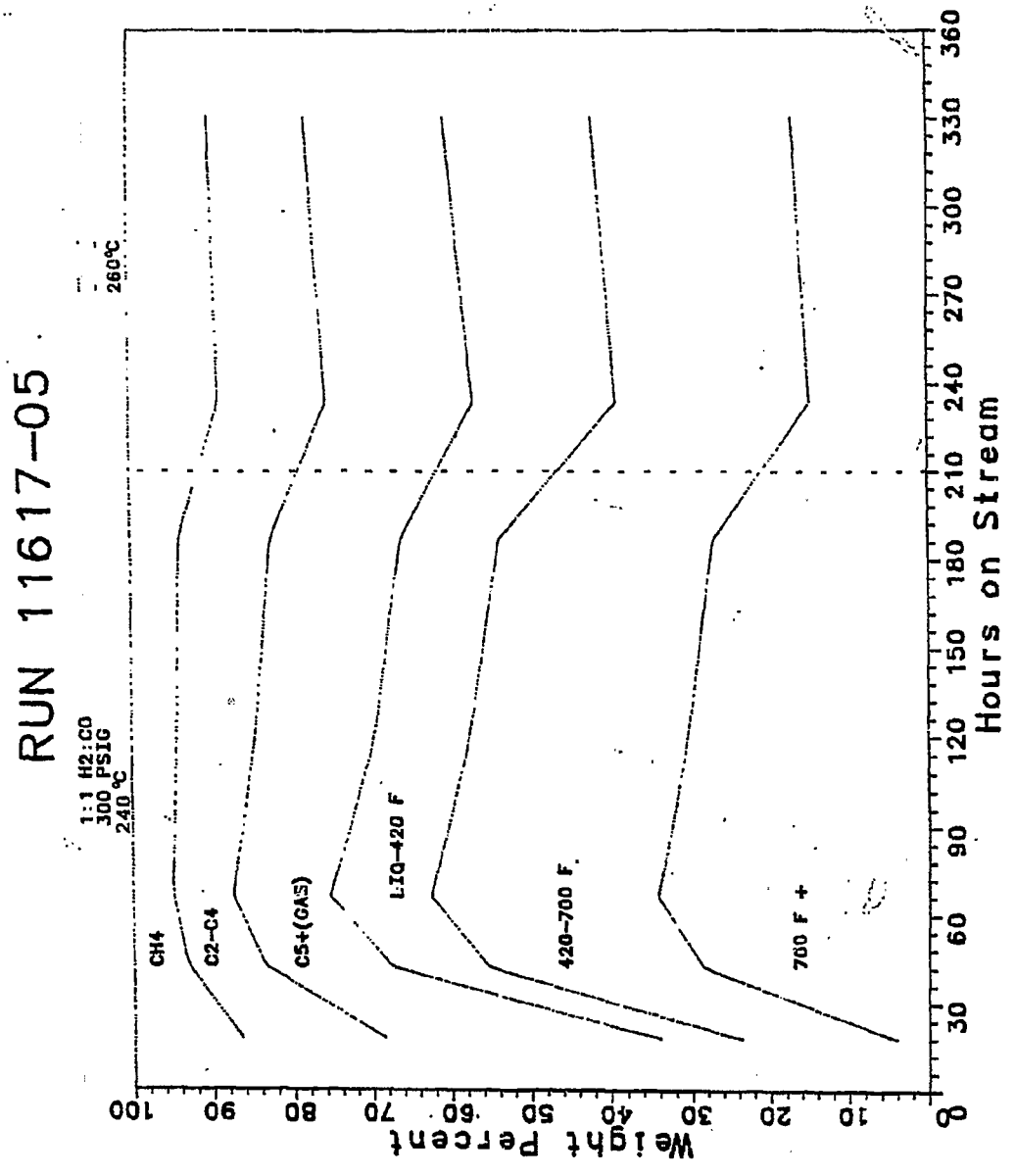

RUN 11617-05
1:1 H2:CO
300 PSIG
240 °C
260°C
CH4
C2-C4
C5+(GAS)
LIQ-420 F
420-700 F
700 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
30
60
90
120
150
180
210
240
270
300
330
360

Fig. B145

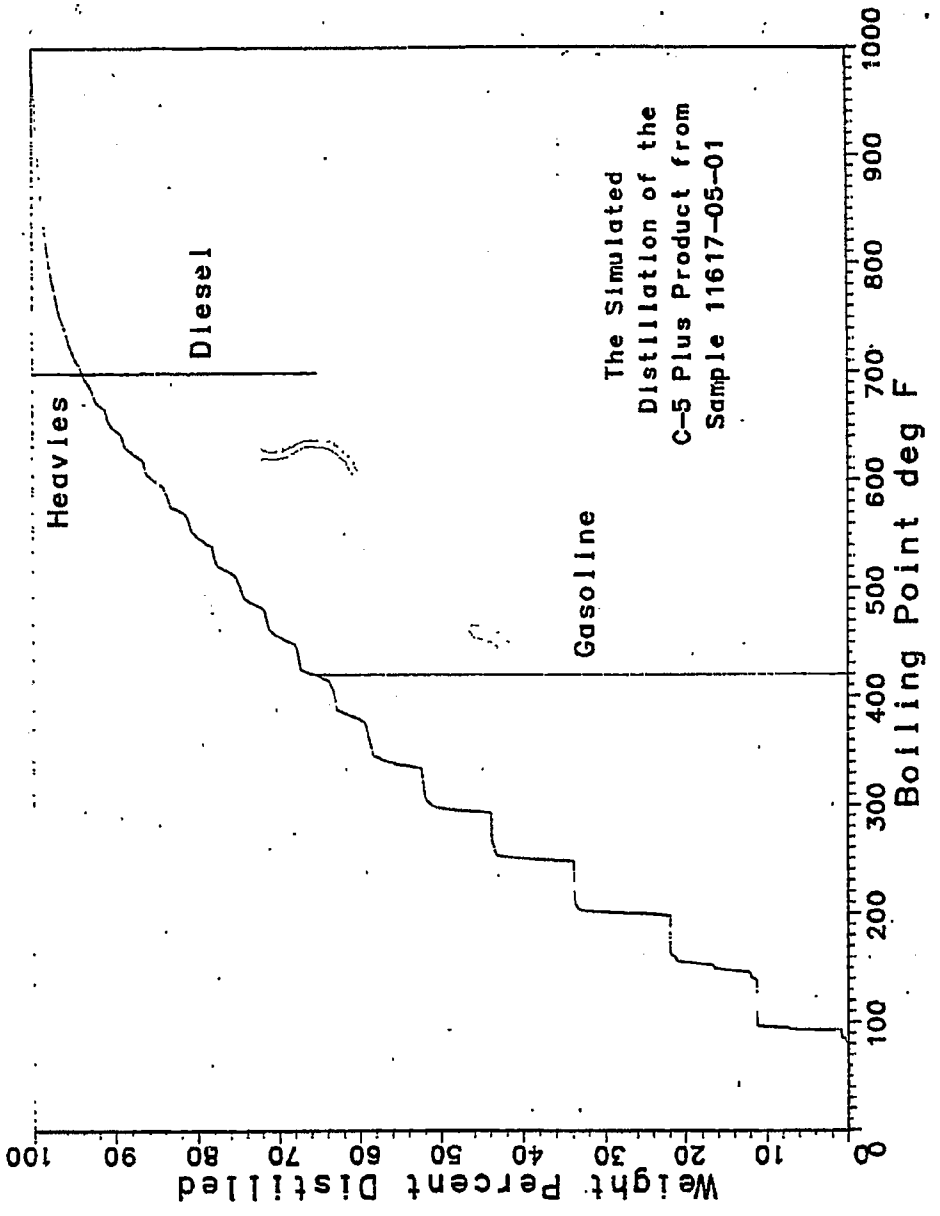

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-05-01
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B146

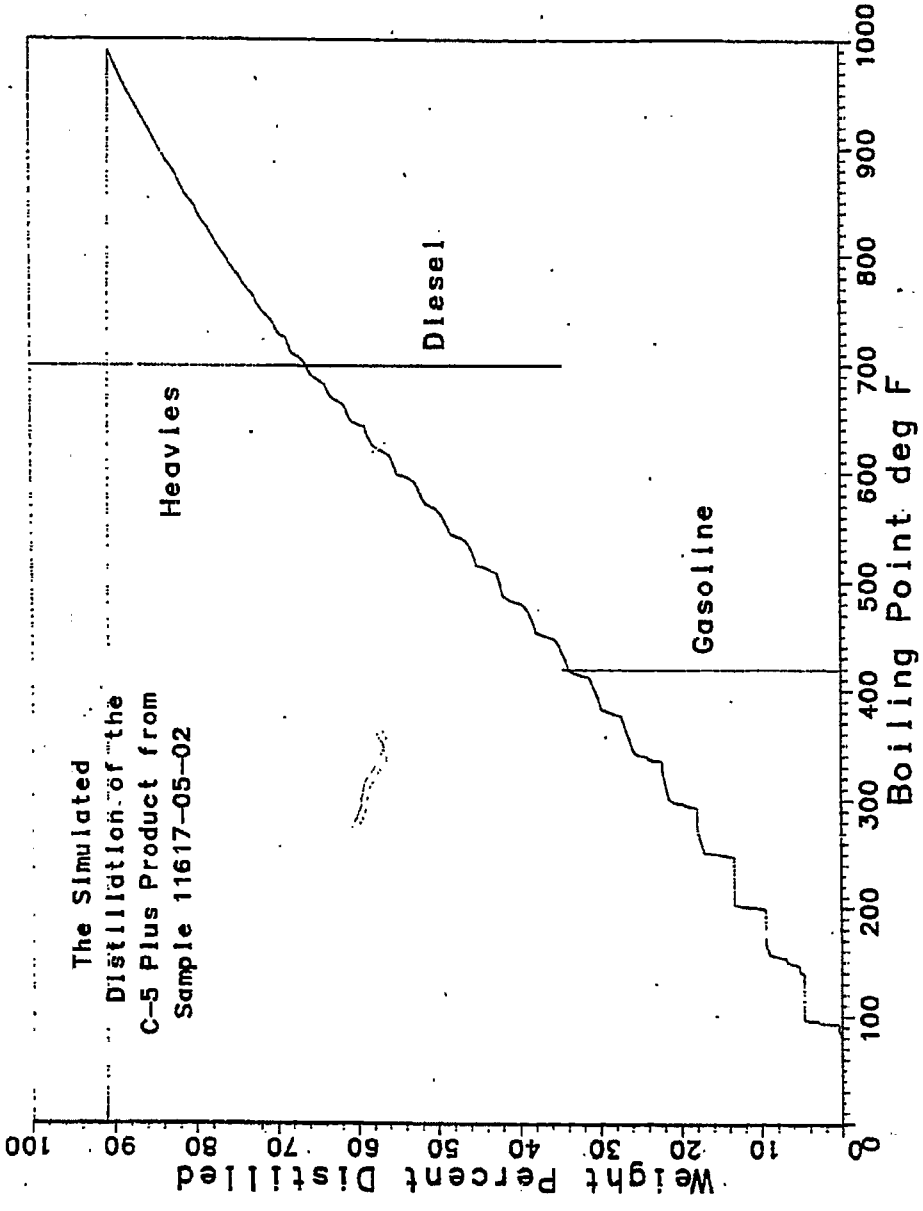

The Simulated Distillation of the C-5 Plus Product from Sample 11617-05-02
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B147

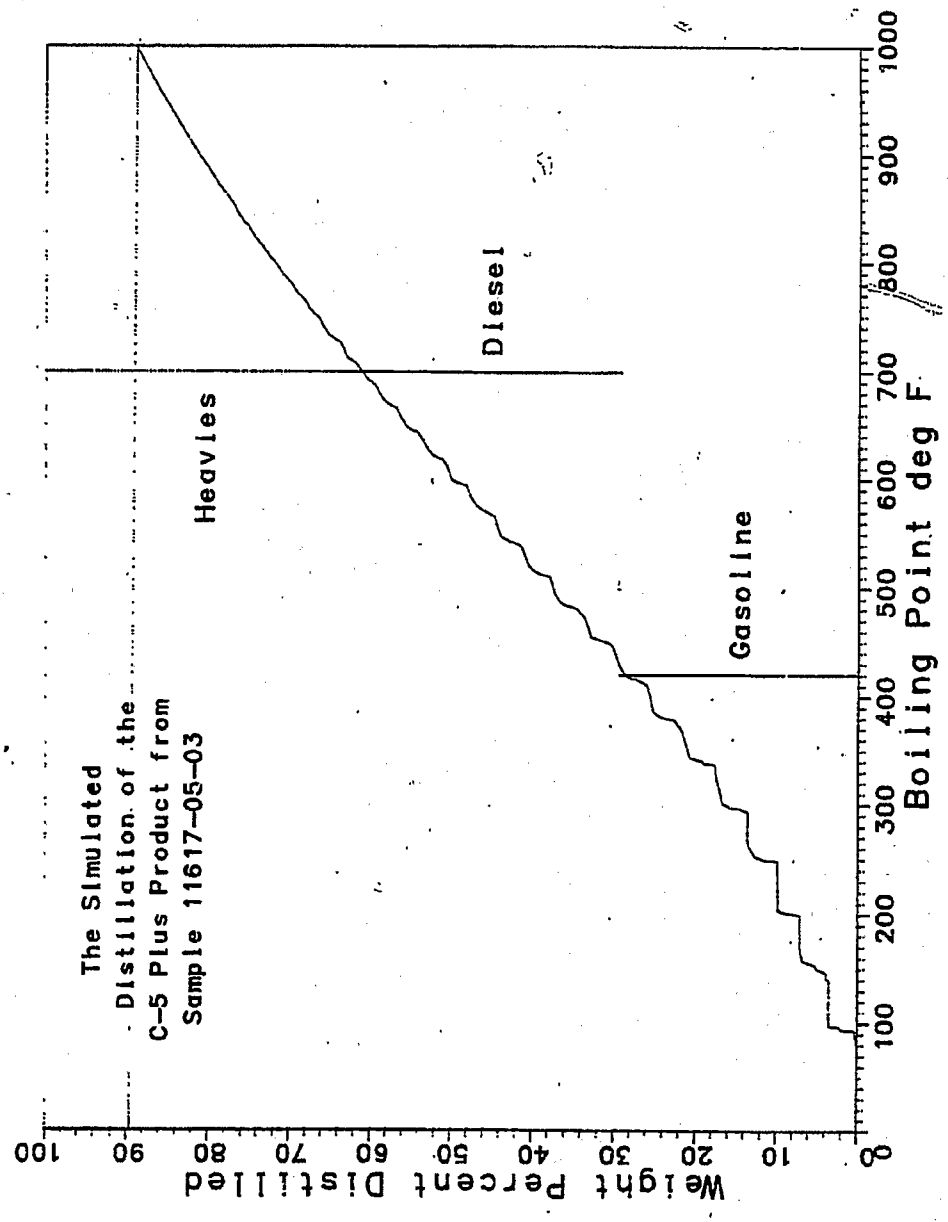

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-05-03
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B148

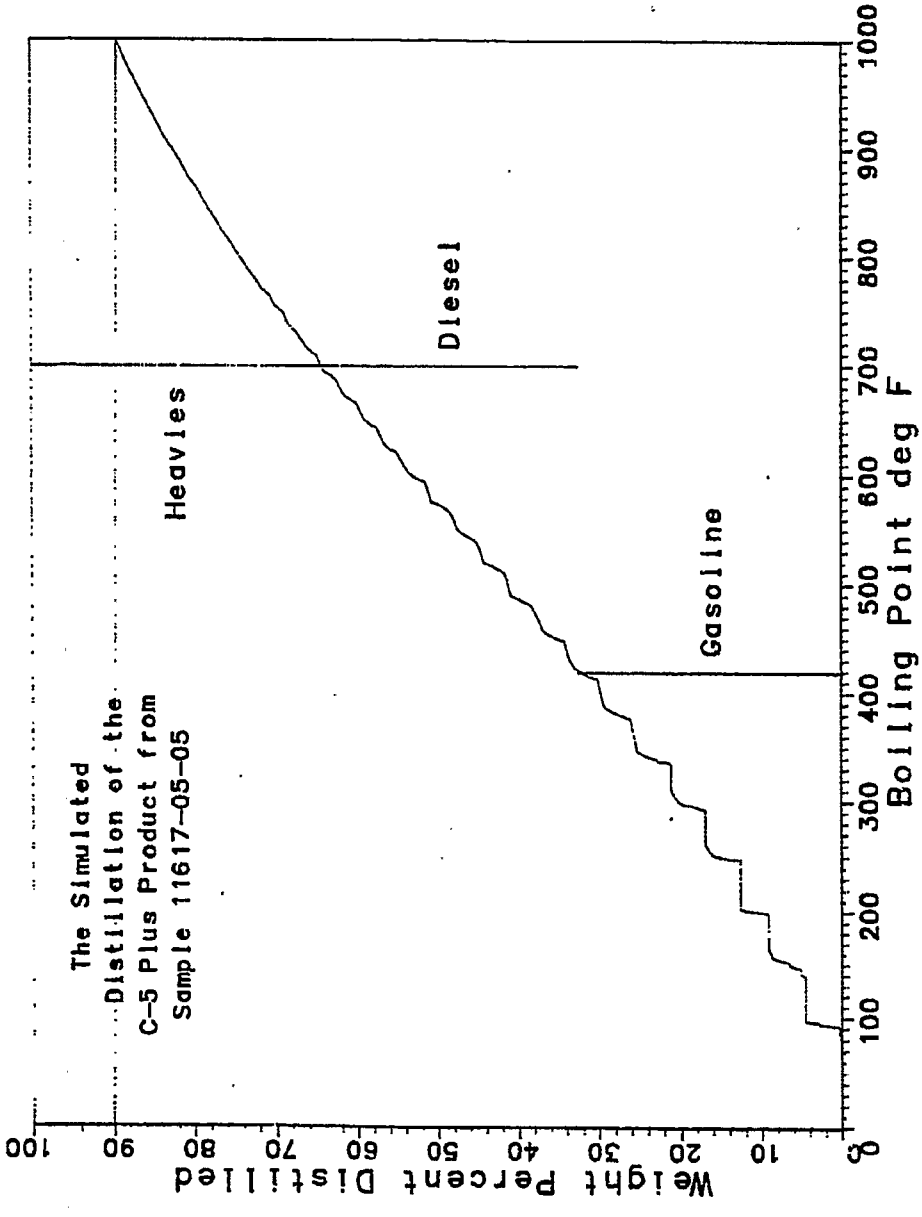

The Simulated Distillation of the C-5 Plus Product from Sample 11617-05-05
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B149

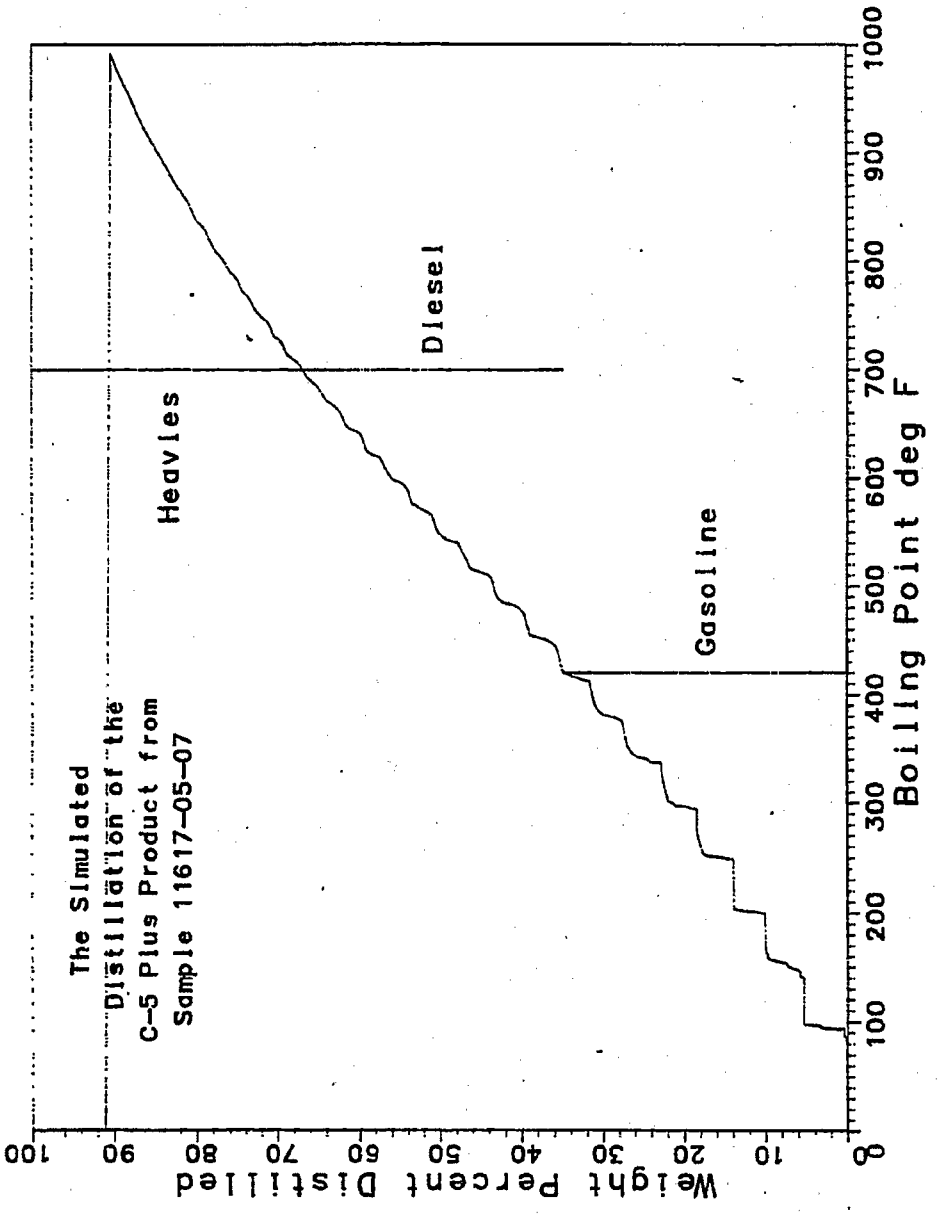

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-05-07
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B150

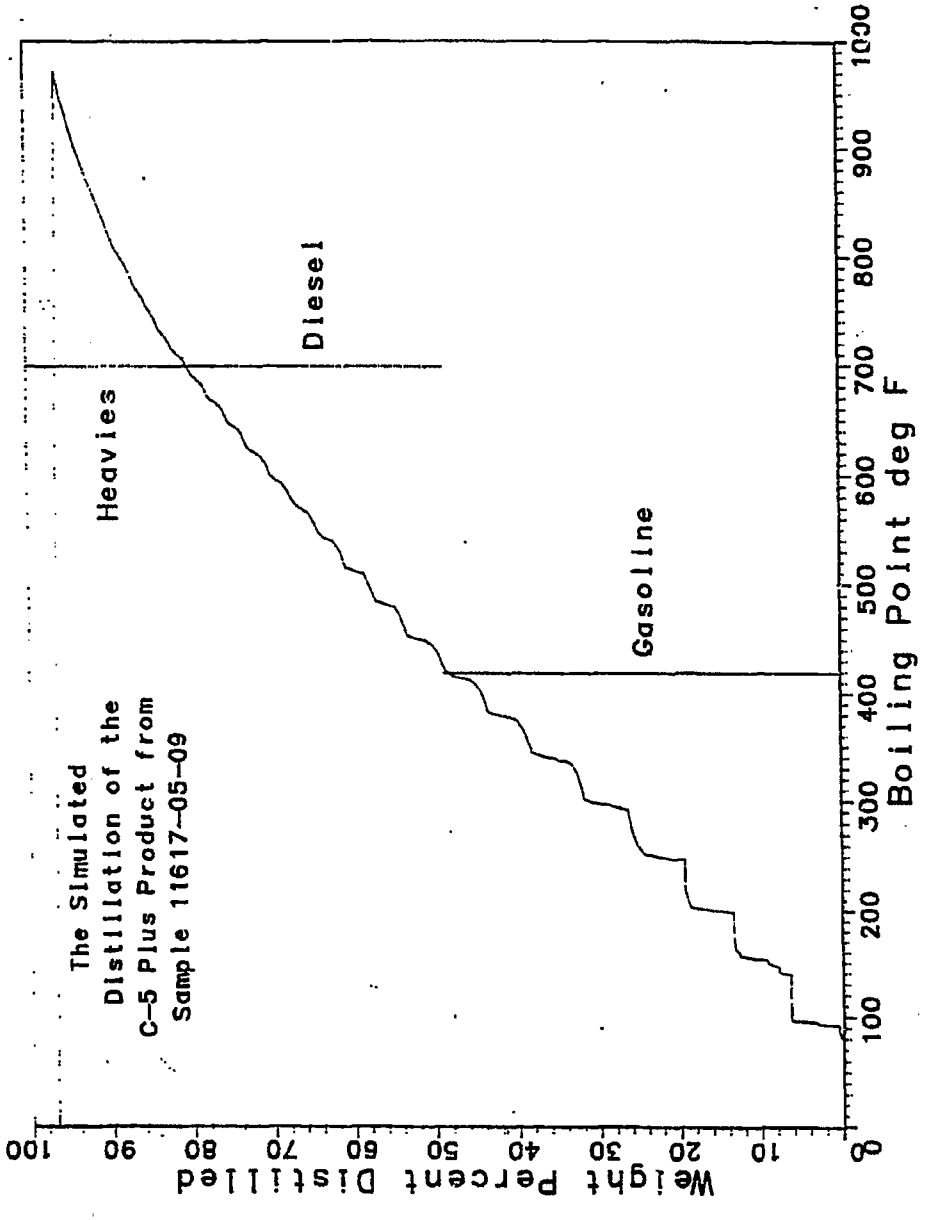

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-05-09
Heavies
Diesel
Gasoline
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point deg F
100
200
300
400
500
600
700
800
900
1000

Fig. B151

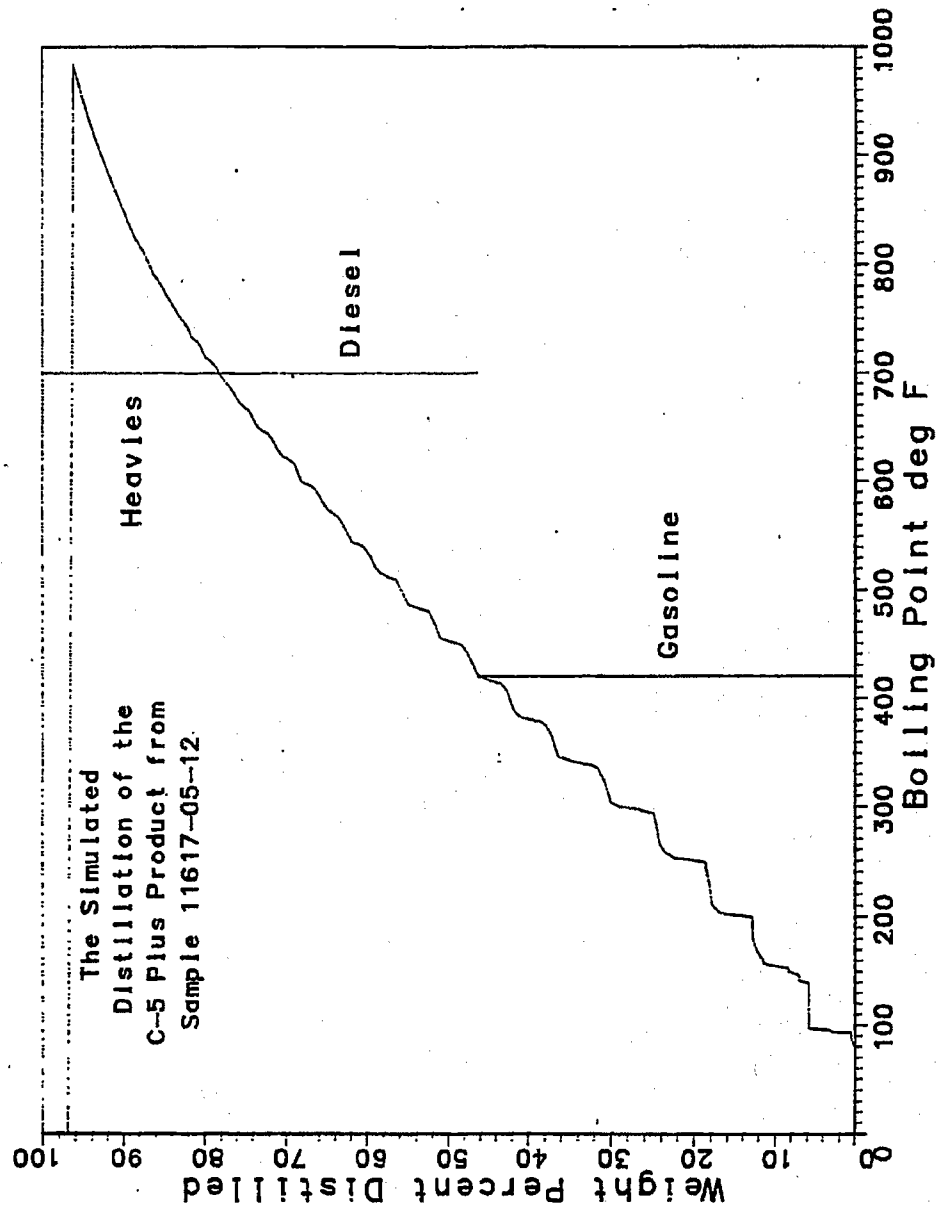

The Simulated
Distillation of the
C-5 Plus Product from
Sample 11617-05-12
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B152

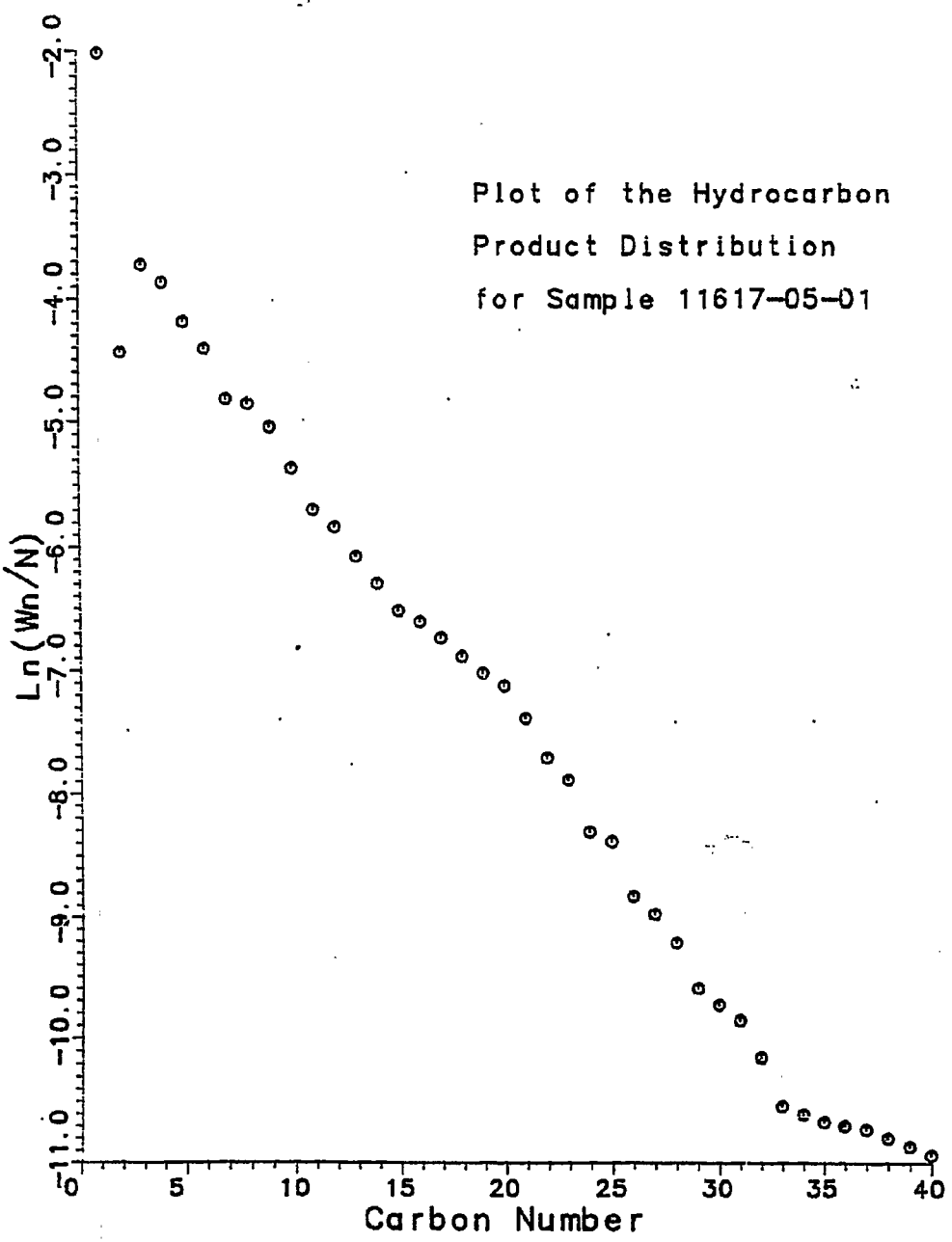

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-05-01
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B153

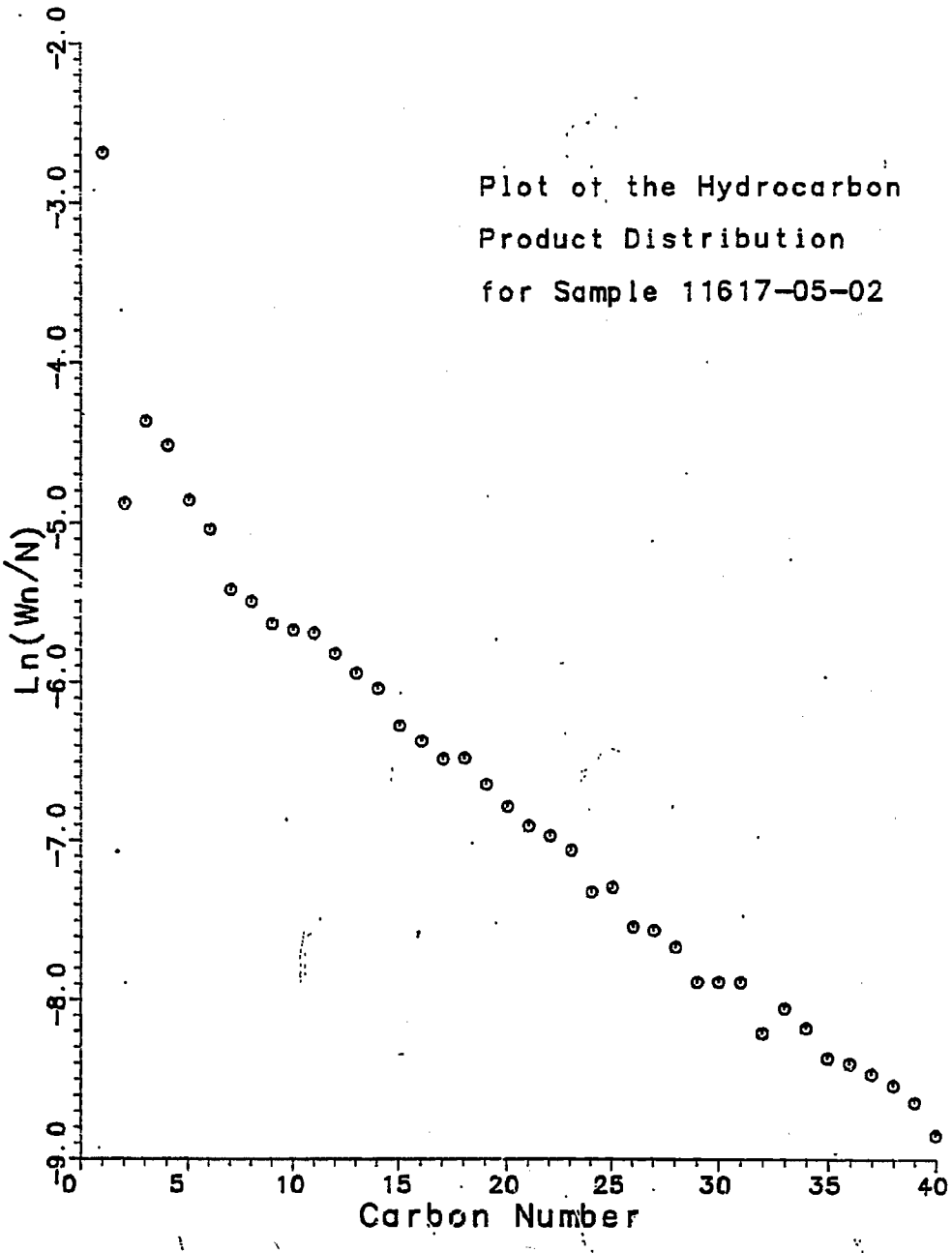

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-05-02
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B154

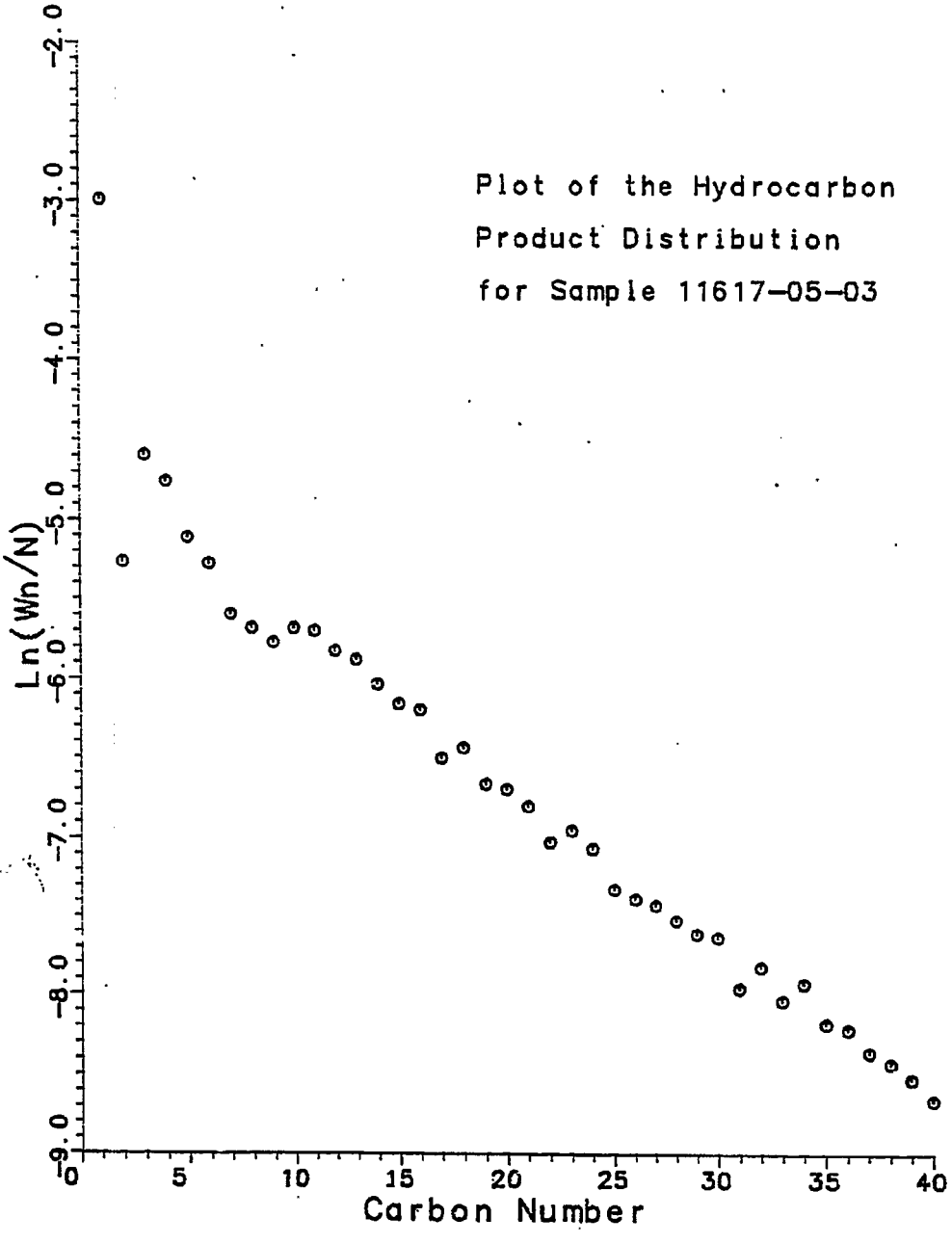

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-05-03
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B155

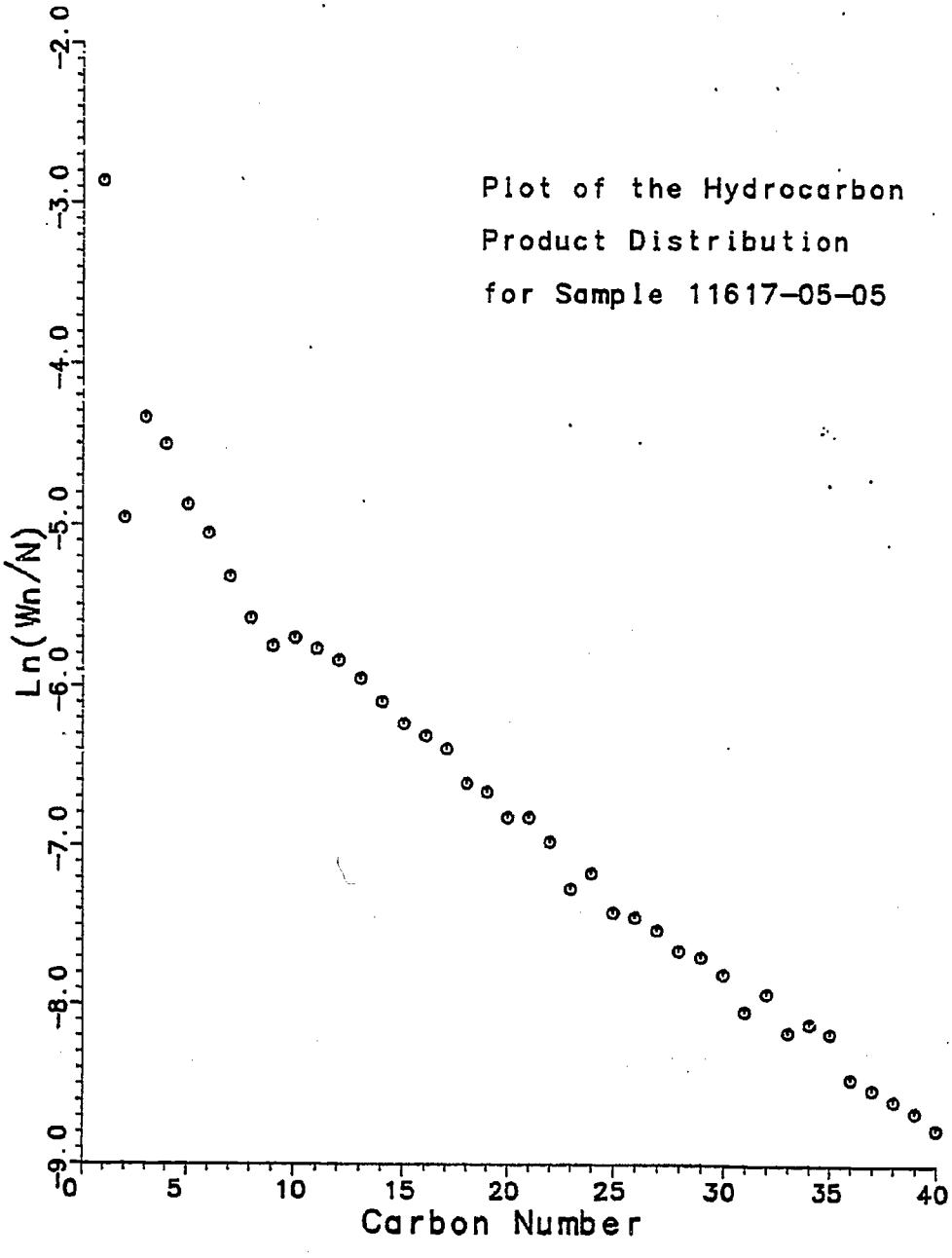
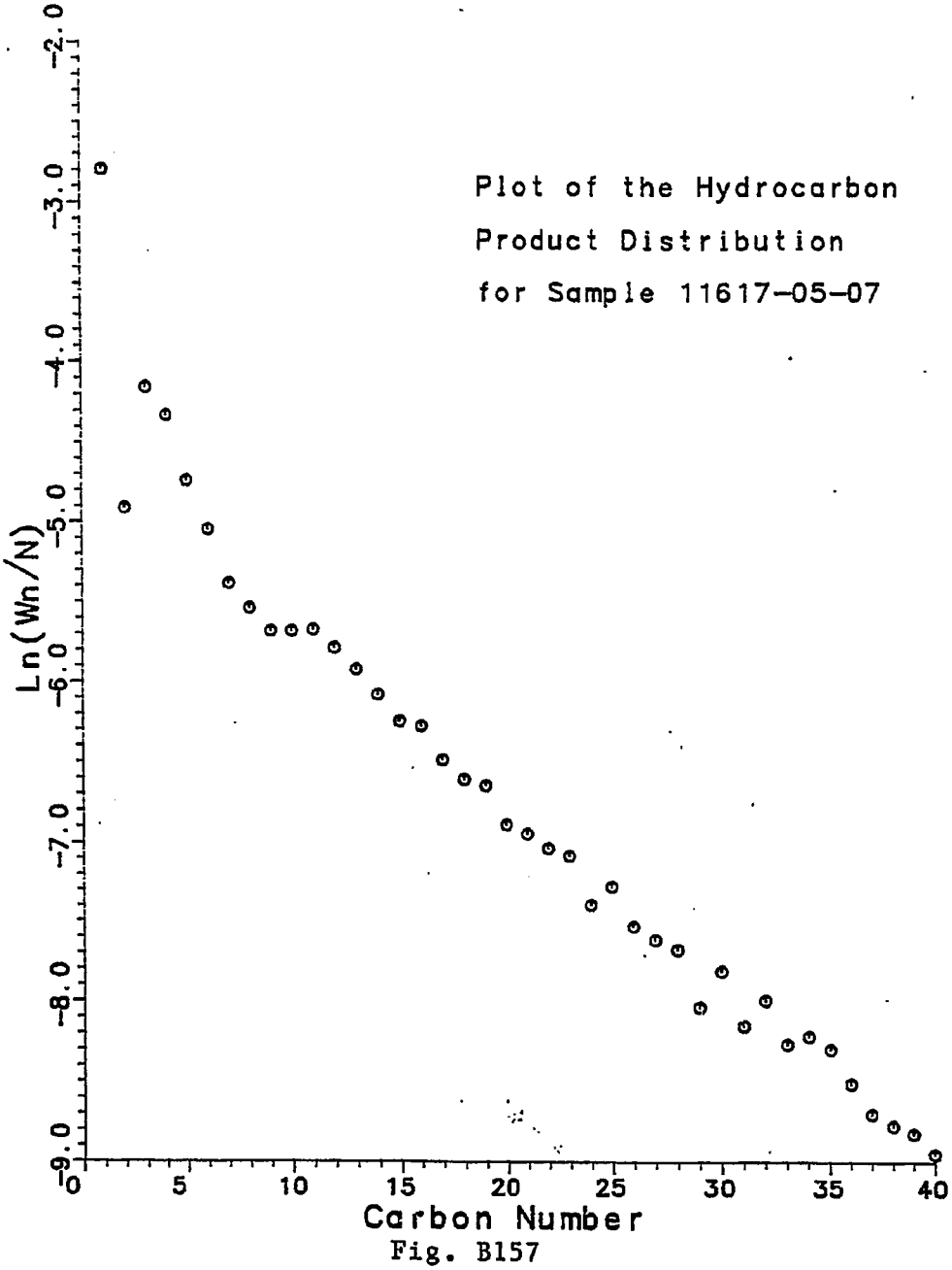

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-05-05
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B156


Plot of the Hydrocarbon
Product Distribution
for Sample 11617-05-07
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number
Fig. B157

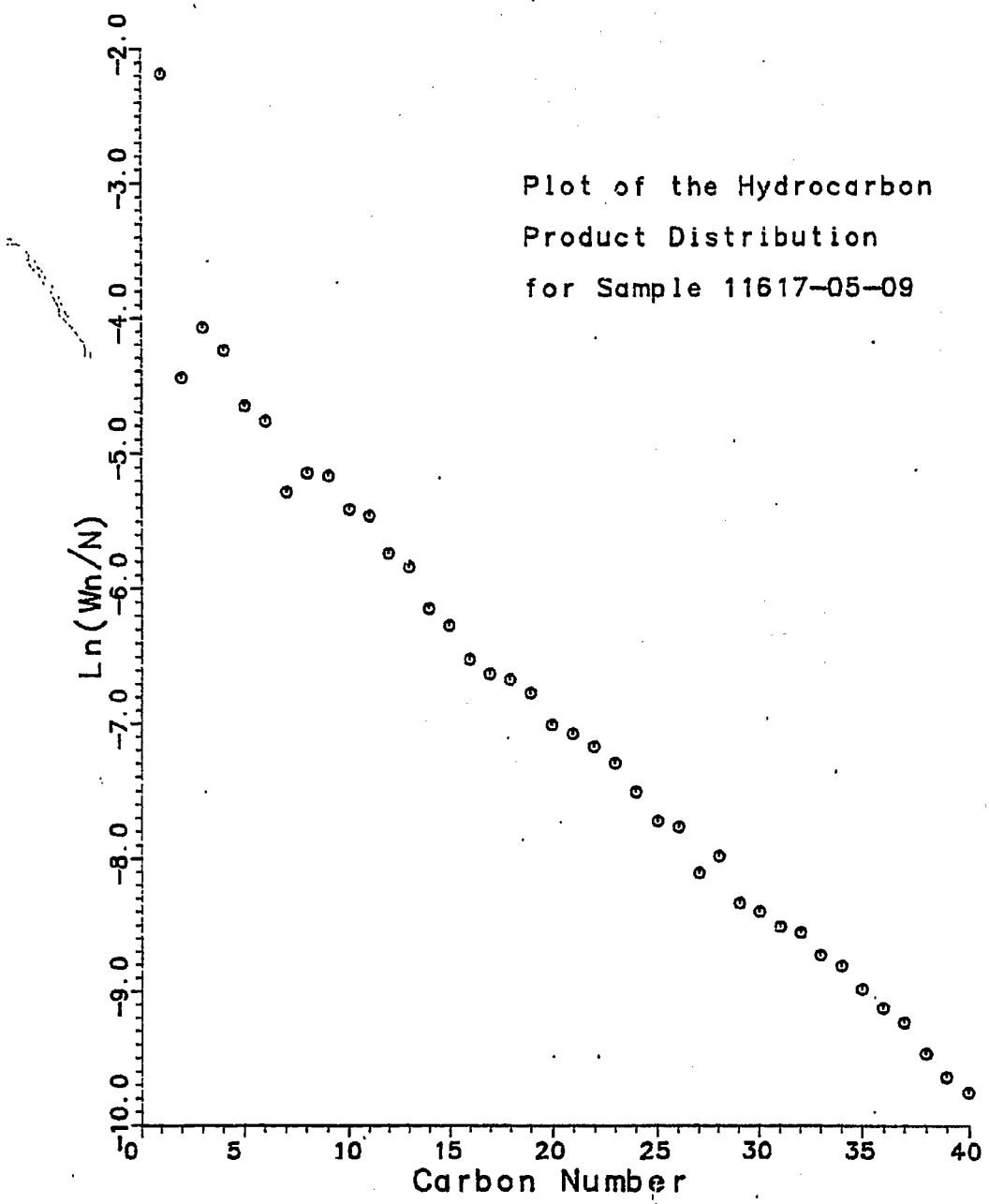

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-05-09
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B158

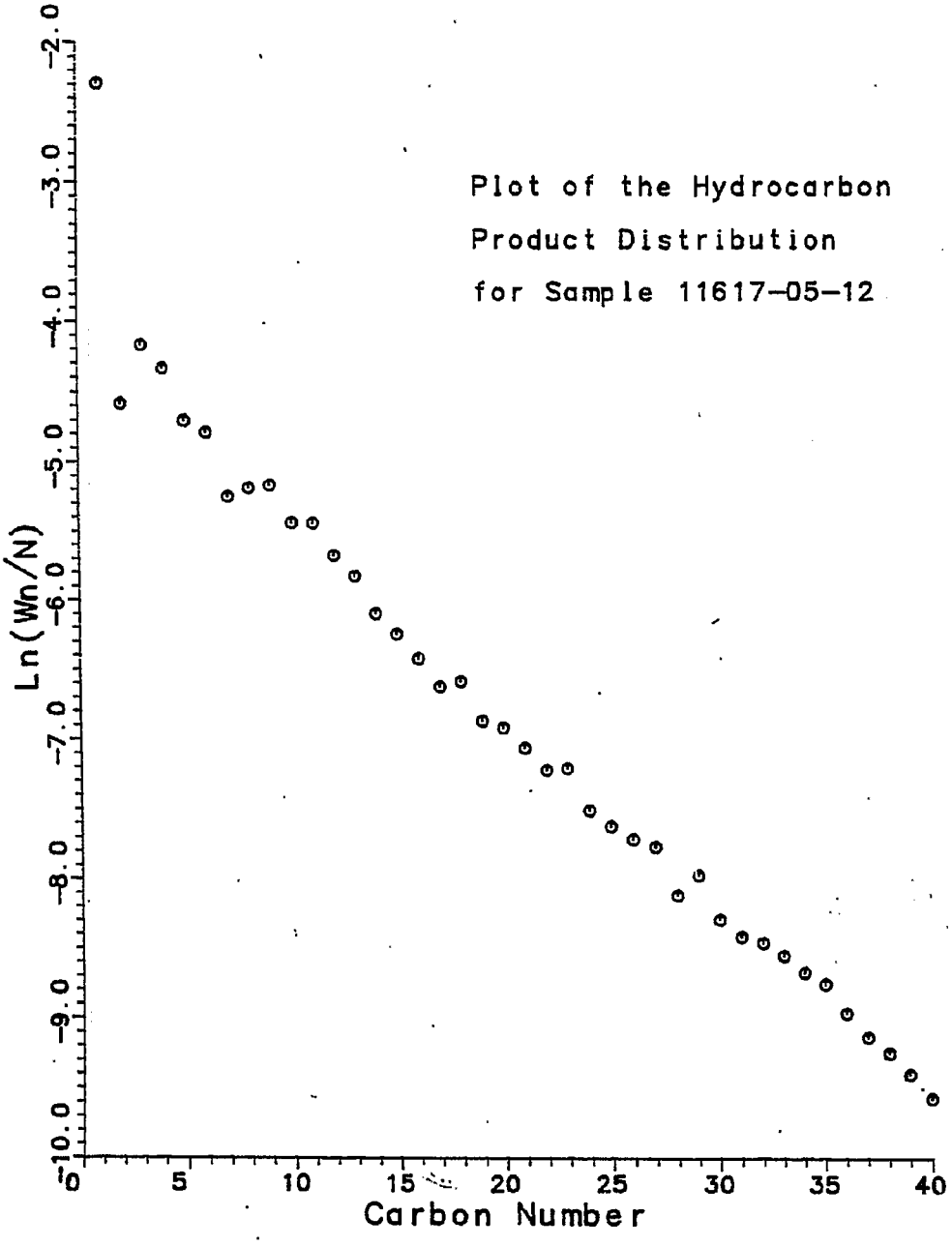
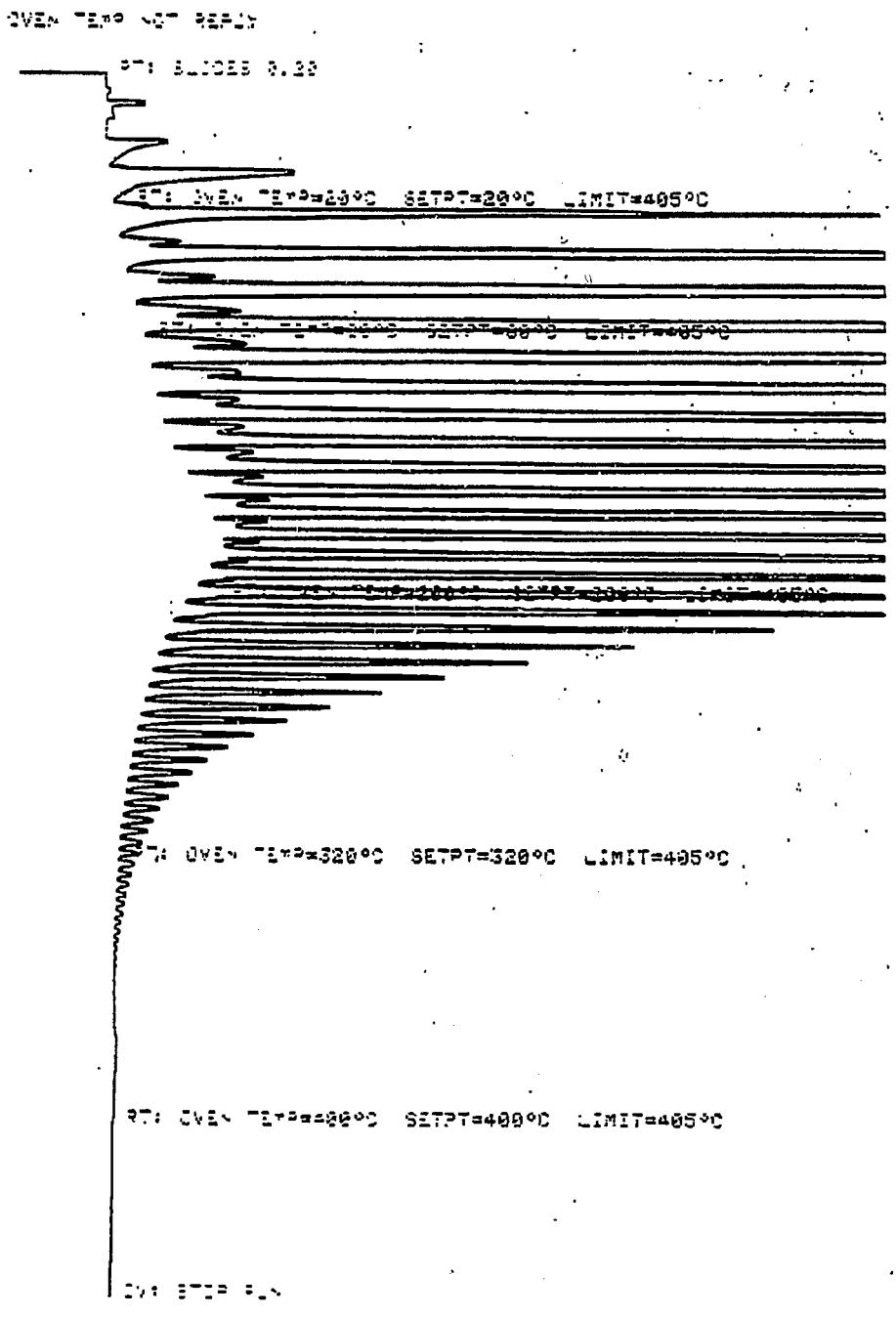

Plot of the Hydrocarbon
Product Distribution
for Sample 11617-05-12
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B159



SAMPLE111617-05-01

Fig. B160

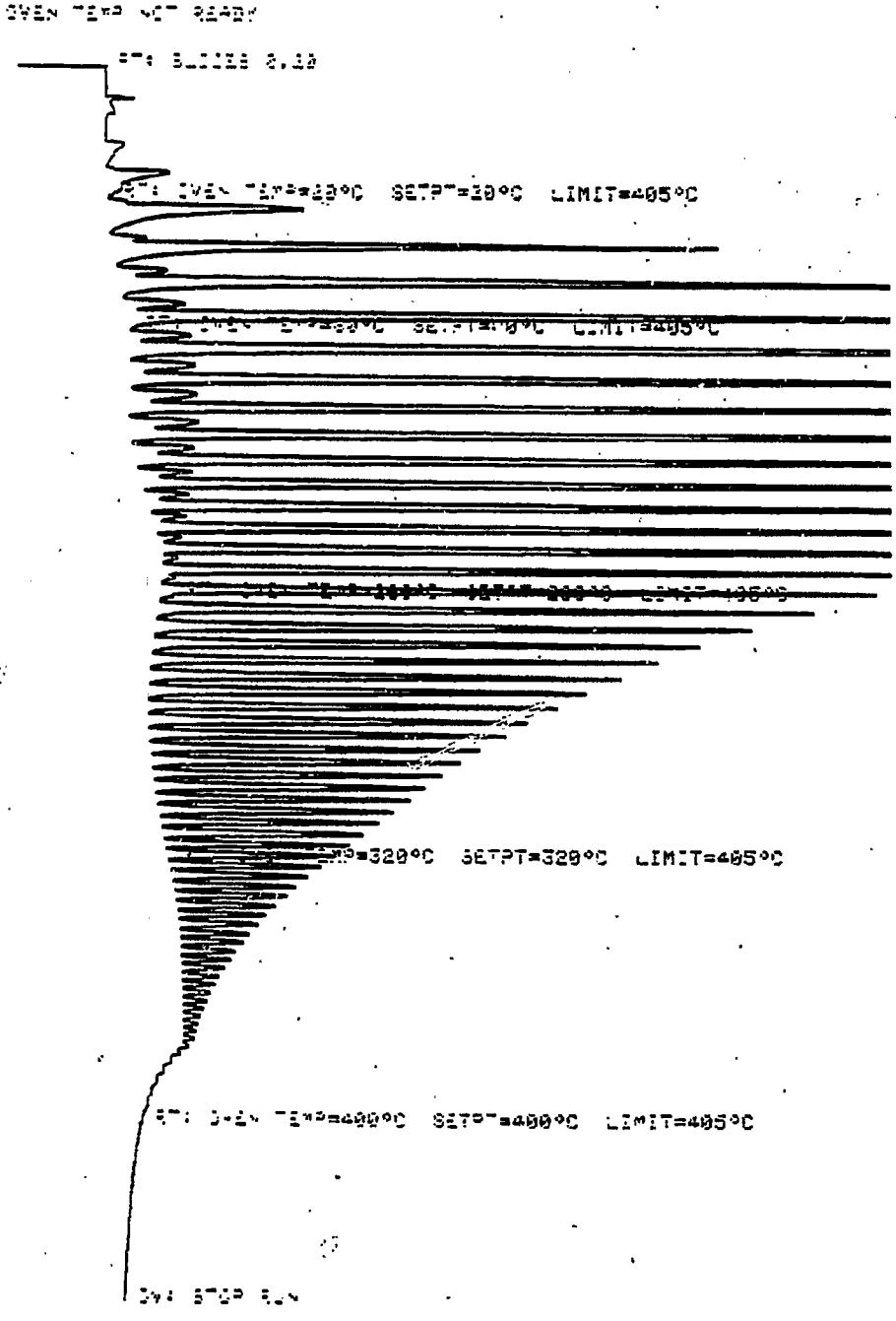

OVEN TEMP NOT READY
SET=320°C SETPT=320°C LIMIT=405°C
SET=400°C SETPT=400°C LIMIT=405°C

Fig. B161

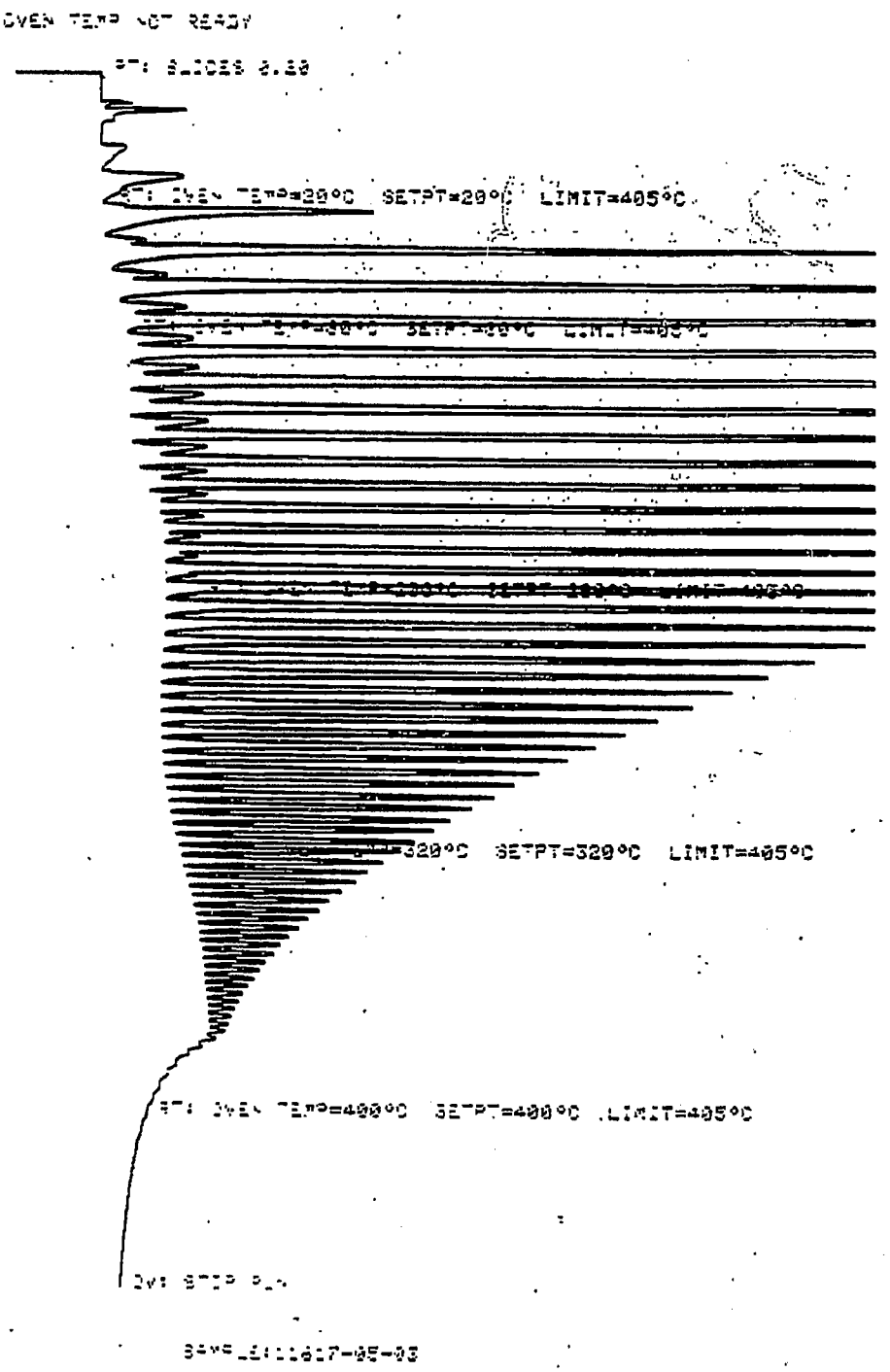

OVEN TEMP NOT READY
SETPT=320°C LIMIT=405°C
SETPT=400°C LIMIT=405°C

Fig. B162

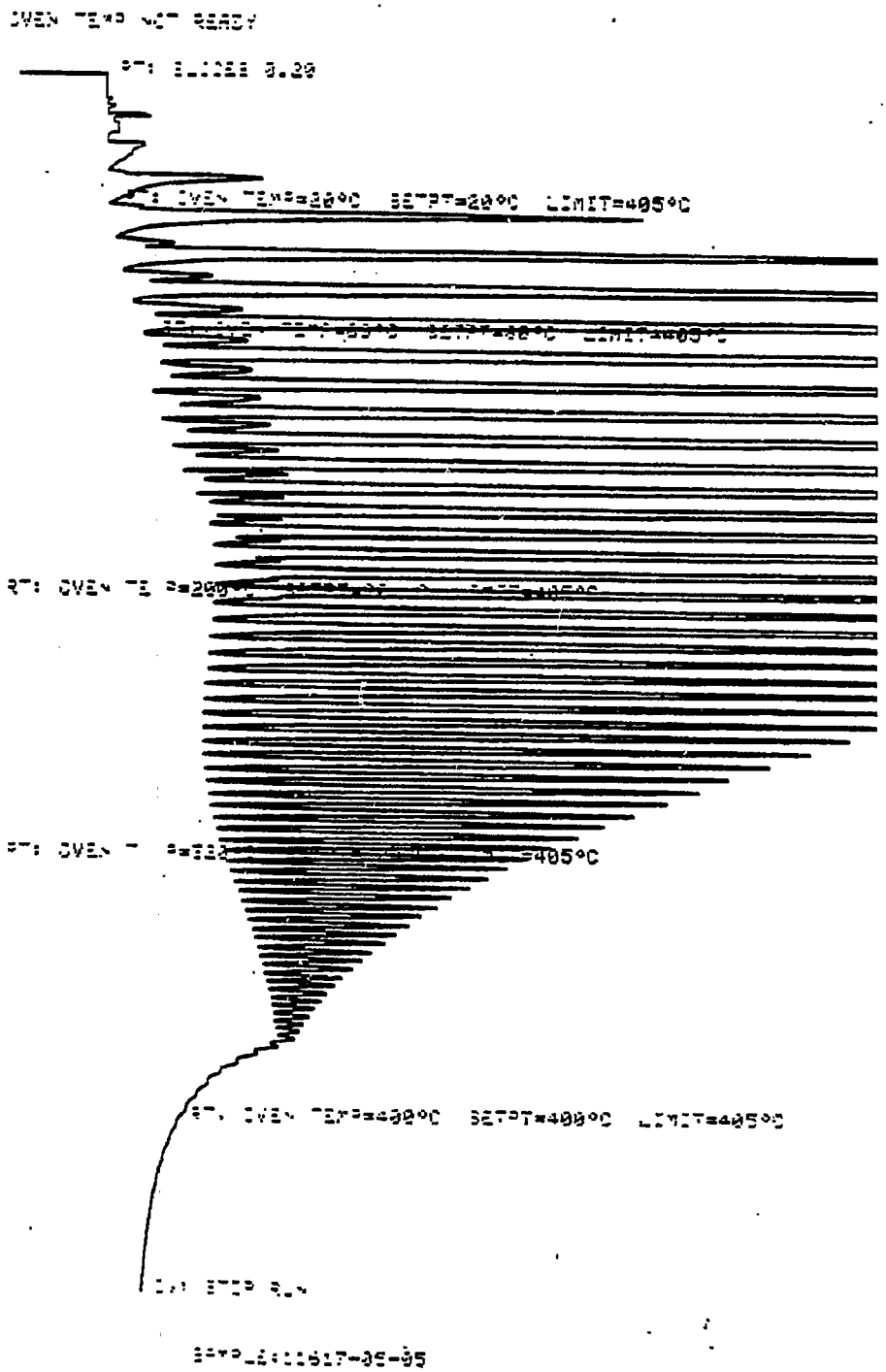

OVEN TEMP NOT READY
RT: OVEN TEMP=200°C SETPT=200°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B163

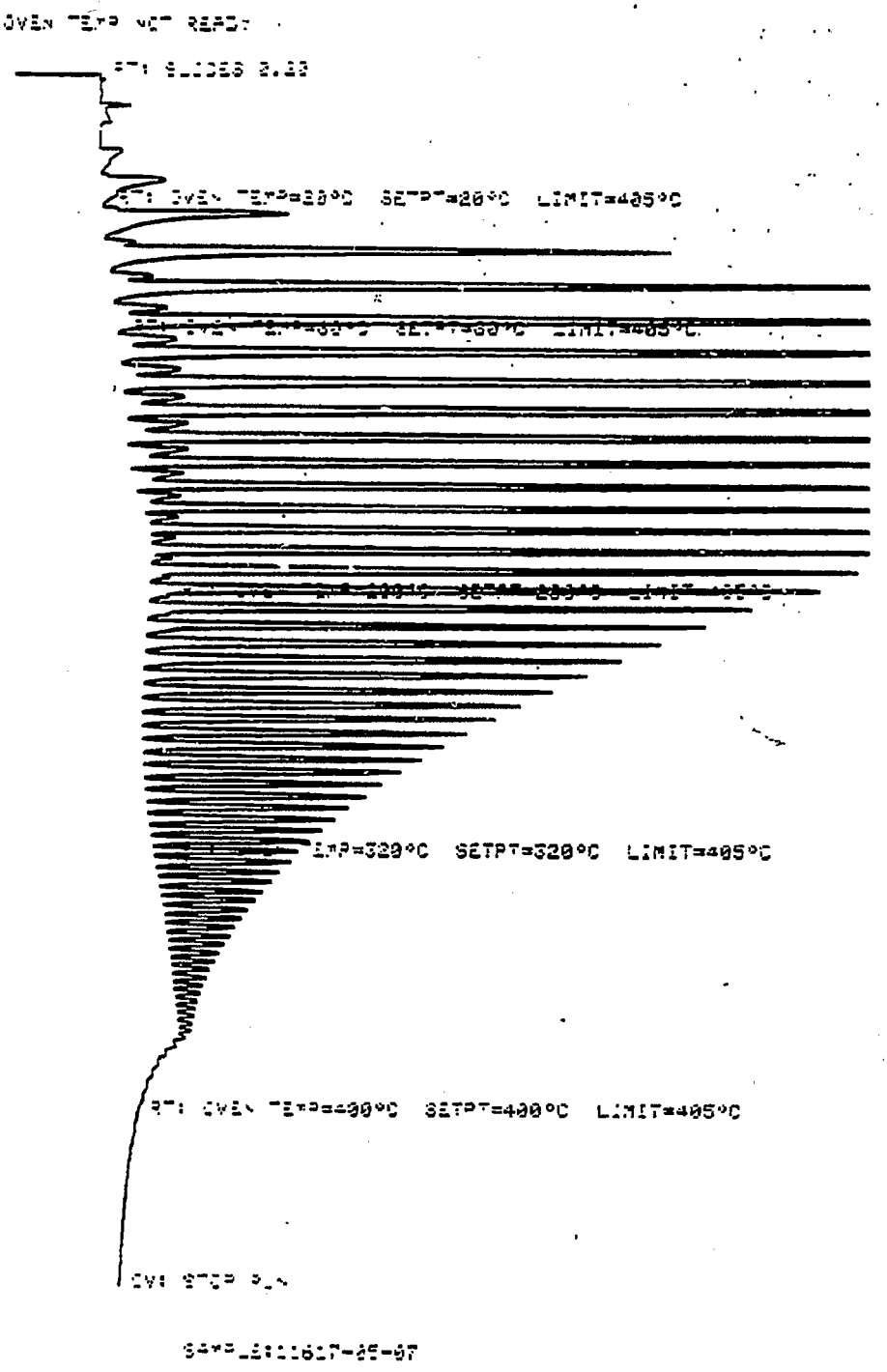

OVEN TEMP SET READY
SET OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
SET OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B164

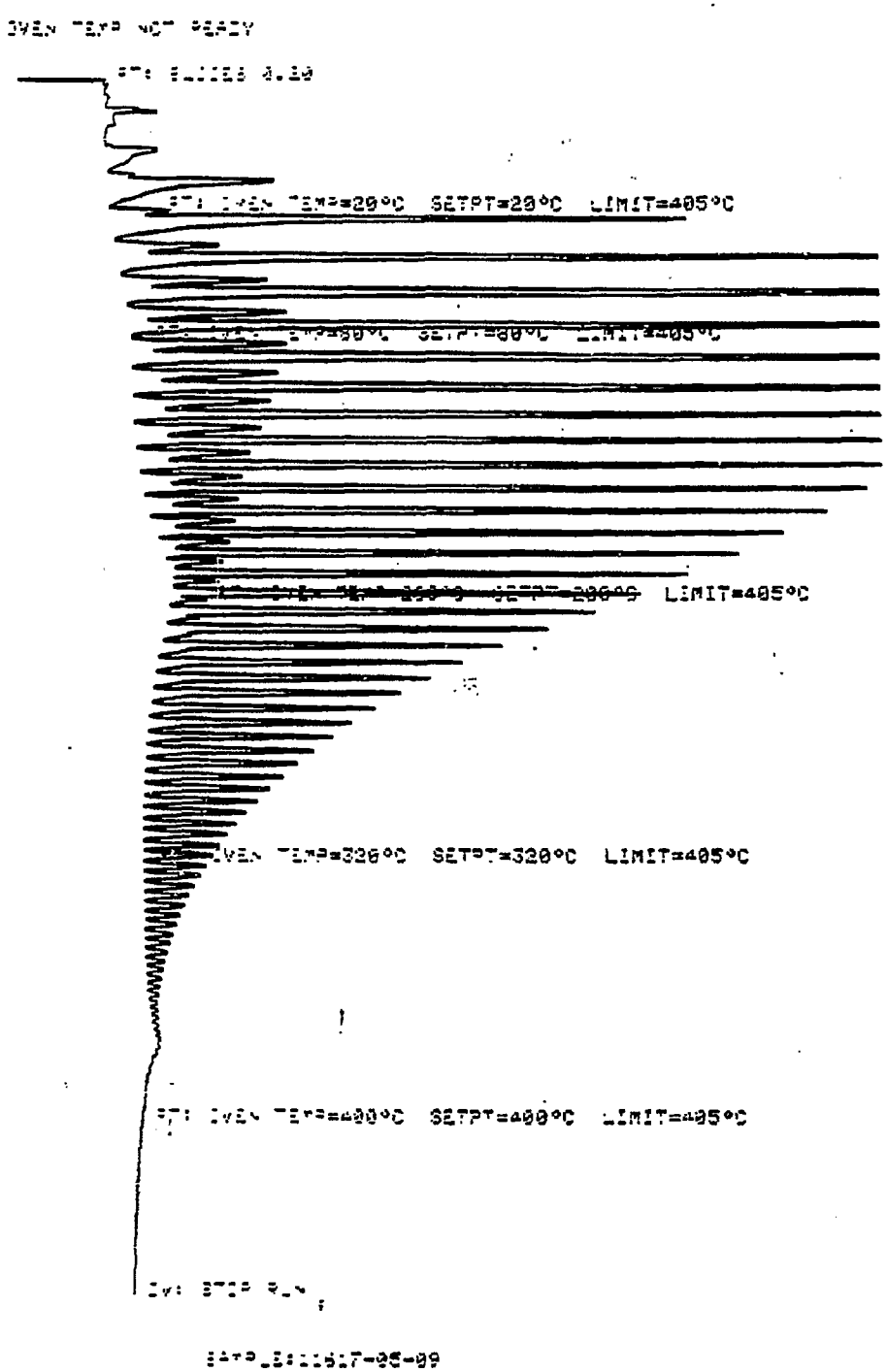


Fig. B165

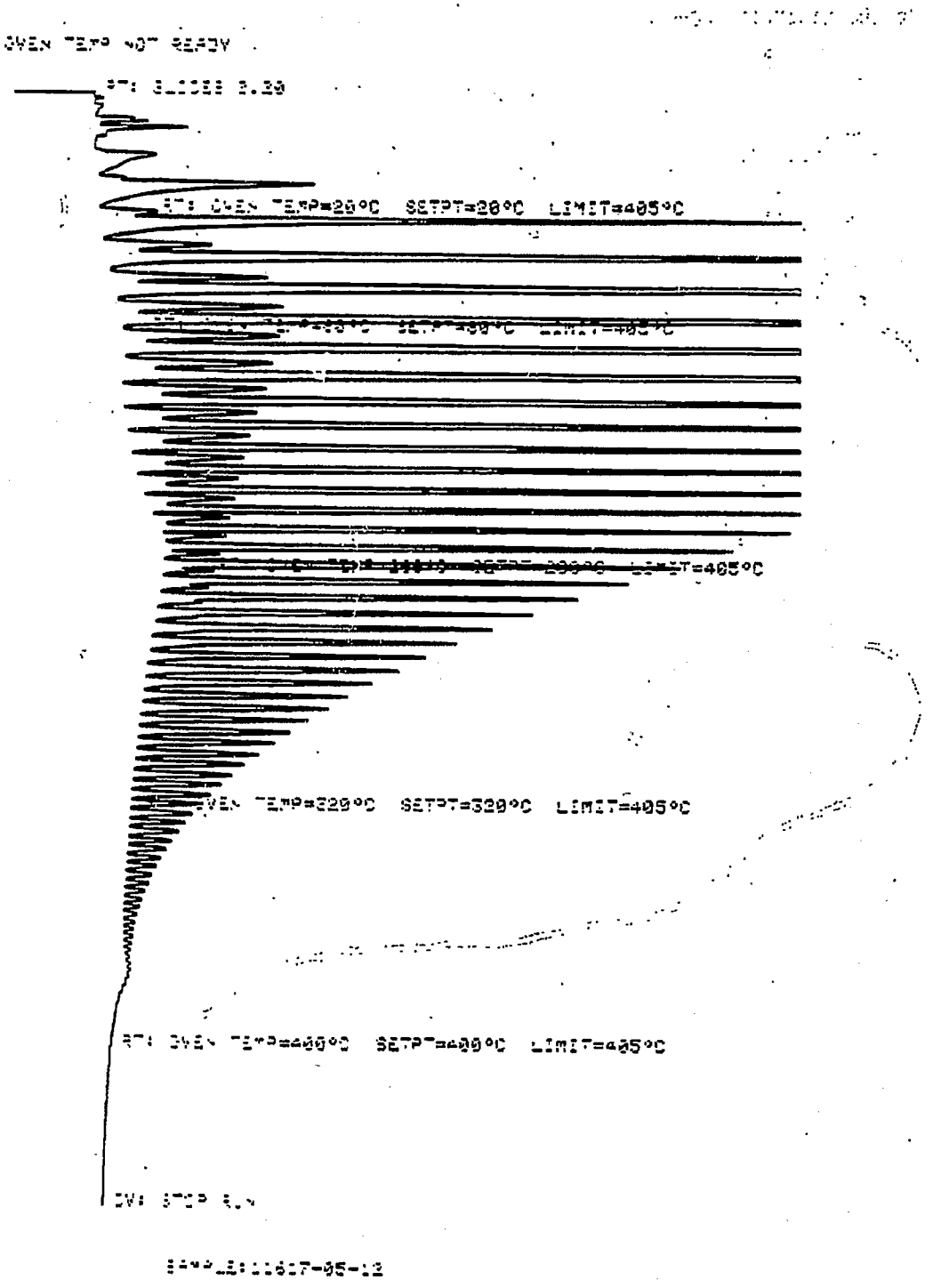

RT: OVEN TEMP=20°C SETPT=20°C LIMIT=405°C
RT: OVEN TEMP=320°C SETPT=320°C LIMIT=405°C
RT: OVEN TEMP=400°C SETPT=400°C LIMIT=405°C

Fig. B166

Table B17

FILE: 1161705A TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-05
CATALYST CO/X11-U103 250 CC 106.1 G AFTER USE:159.7 G (+53.6 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV (CAT#12524-9)

RUN & SAMPLE NO.	11617-05-01	617-05-02	617-05-03	617-05-04	617-05-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	18.0	42.5	66.5	91.5	120.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	241	240	240	240	240
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	18.00	24.50	24.00	25.00	28.50
EFFLNT GAS LITER	762.16	1028.50	1001.04	1146.25	1286.20
GM AQUEOUS LAYER	121.38	175.19	160.77	162.25	183.66
GM OIL	20.52	98.33	131.15	117.22	130.75
MATERIAL BALANCE					
GM ATOM CARBON %	86.79	93.93	97.08	101.40	99.84
GM ATOM HYDROGEN %	78.00	95.97	102.86	103.06	101.99
GM ATOM OXYGEN %	100.16	97.92	92.54	98.90	97.10
RATIO CHX/(H2O+CO2)	0.5281	0.8701	1.1613	1.0907	1.1013
RATIO X IN CHX	2.3560	2.2498	2.2167	2.2303	2.2301
USAGE H2/CO PRODT	2.5606	1.9329	1.7870	1.8359	1.8523
FEED H2/CO FRM EFFLNT	0.8988	1.0218	1.0595	1.0164	1.0215
RESIDUAL H2/CO RATIO	0.4906	0.5971	0.6526	0.6364	0.6373
RATIO CO2/(H2O+CO2)	0.0758	0.1013	0.0760	0.0754	0.0660
K SHIFT IN EFFLNT	0.0402	0.0673	0.0537	0.0519	0.0450
SPECIFIC ACTIVITY SA	2.3334	3.1952	3.2712	2.9776	2.9032
CONVERSION					
ON CO %	19.72	31.79	35.87	31.68	31.62
ON H2 %	56.18	60.14	60.50	57.22	57.34
ON CO+H2 %	36.98	46.12	48.54	44.55	44.62
PRDT SELECTIVITY,WT %					
CH4	13.41	6.85	5.03	5.74	5.74
C2 HC'S	2.37	1.53	1.04	1.19	1.41
C3H8	2.14	1.40	1.09	1.34	1.34
C3H6=	5.11	2.41	1.95	2.53	2.58
C4H10	2.67	1.51	1.16	1.44	1.47
C4H8=	5.74	2.85	2.28	2.85	2.97
C5H12	2.90	1.66	1.27	1.56	1.60
C5H10=	4.73	2.23	1.75	2.21	2.23
C6H14	3.73	2.22	1.79	2.17	2.23
C6H12= & CYCLO'S	3.63	1.68	1.28	1.54	1.62
C7+ IN GAS	19.53	8.10	5.88	7.05	7.36
LIQ HC'S	34.04	67.56	75.46	70.37	69.44
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	31.44	16.55	12.56	15.10	15.52
C5 -420 F	44.73	28.05	24.88	49.72	26.99
420-700 F	19.64	26.89	28.45	28.15	27.15
700-END PT	4.19	28.51	34.11	7.04	30.35

Table B17 (continued)

FILE: 1161705A TSS4Q1 A1

C5+-END PT	68.56	83.45	87.44	84.90	84.48
ISO/NORMAL MOLE RATIO					
C4	0.0287	0.0225	0.0223	0.0192	0.0213
C5	0.0782	0.0823	0.0714	0.0737	0.0678
C6	0.1528	0.2356	0.2210	0.2405	0.2309
C4=	0.0571	0.0578	0.0630	0.0619	0.0581
PARAFFIN/OLEFIN RATIO					
C3	0.4000	0.5529	0.5312	0.5064	0.4955
C4	0.4484	0.5107	0.4921	0.4862	0.4765
C5	0.5968	0.7225	0.7025	0.6861	0.6995
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8091	0.8837	0.8971	0.7738	0.8848
RATIO CH4/(1-A)**2	3.6810	5.0635	4.7561	1.1233	4.3281
ALPHA FRM CORRELATION	0.8466	0.8371	0.8327		0.8339
ALPHA (EXPTL/CORR)	0.9558	1.0557	1.0773		1.0611
W%CH4 FRM CORRELATION	11.2644	13.9900	15.3339		14.9753
W%CH4 (EXPTL/CORR)	1.1904	0.4897	0.3282		0.3834
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	335	377	378		377
16	347	415	417		416
50	511	645	666		652
84	671	941	962		960
90	718	1016	1041		1044
RANGE(16-84 %)	324	526	545		544
WT % @ 420 F	30.00	18.00	17.10	50.00	17.20
WT % @ 700 F	87.70	57.80	54.80	90.00	56.30

Table B18

FILE: 1161705B TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-05
CATALYST CO/X11-U103 250 CC 106.1 G AFTER USE:159.7 G (+53.6 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV (CAT#12524-9)

RUN & SAMPLE NO.	11617-05-06	617-05-07	617-05-08	617-05-09	617-05-10
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	162.5	186.5	210.5	233.5	259.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	240	239	260	260	260
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	42.50	24.00	24.00	23.00	25.50
EFFLNT GAS LITER	1964.78	1146.72	926.40	860.89	961.35
GM AQUEOUS LAYER	274.96	150.66	172.82	172.57	194.67
GM OIL	178.20	95.91	100.83	99.30	116.08
MATERIAL BALANCE					
GM ATOM CARBON %	99.00	100.23	98.18	94.65	96.07
GM ATOM HYDROGEN %	102.46	102.67	99.57	98.48	100.10
GM ATOM OXYGEN %	97.79	99.20	98.13	95.81	95.92
RATIO CHX/(H2O+CO2)	1.0451	1.0394	1.0016	0.9668	1.0043
RATIO X IN CHX	2.2365	2.2381	2.3679	2.3477	2.3315
USAGE H2/CO PRODT	1.9157	1.9306	1.6201	1.7008	1.7311
FEED H2/CO FRM EFFLNT	1.0349	1.0243	1.0141	1.0404	1.0419
RESIDUAL H2/CO RATIO	0.6573	0.6618	0.5452	0.5526	0.5451
RATIO CO2/(H2O+CO2)	0.0571	0.0534	0.2150	0.1816	0.1582
K SHIFT IN EFFLNT	0.0398	0.0373	0.1493	0.1226	0.1025
SPECIFIC ACTIVITY SA	2.6473	2.5746	1.8770	1.7359	1.7629
CONVERSION					
ON CO %	30.00	28.57	43.62	42.49	41.89
ON H2 %	55.54	53.85	69.69	69.46	69.60
ON CO+H2 %	42.99	41.36	56.75	56.24	56.03
PRDT SELECTIVITY,WT %					
CH4	6.05	6.11	12.37	11.29	10.67
C2 HC'S	1.45	1.48	2.54	2.35	2.12
C3H8	1.46	1.57	2.86	2.60	2.36
C3H6=	2.85	3.14	2.43	2.55	2.34
C4H10	1.60	1.70	2.54	2.38	2.14
C4H8=	3.27	3.58	3.41	3.40	3.16
C5H12	1.75	1.84	2.78	2.64	2.44
C5H10=	2.41	2.54	2.10	2.13	2.09
C6H14	2.34	2.36	3.91	3.71	3.37
C6H12= & CYCLO'S	1.76	1.51	1.45	1.42	1.35
C7+ IN GAS	7.98	8.05	10.40	8.49	9.35
LIQ HC'S	67.09	66.12	53.20	57.02	58.62
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	16.68	17.57	26.16	24.59	22.78
C5 -420 F	49.78	28.54	47.24	36.24	47.91
420-700 F	26.84	26.65	21.28	24.12	23.45
700-END PT	6.71	27.24	5.32	15.05	5.86

Table B18 (continued)

FILE: 1161705B TSS4Q1 A1

C5+-END PT	83.32	82.43	73.84	75.41	77.22
ISO/NORMAL MOLE RATIO					
C4	0.0221	0.0222	0.0217	0.0193	0.0169
C5	0.0753	0.0731	0.0920	0.0898	0.0922
C6	0.2281	0.2129	0.4271	0.4078	0.4170
C4=	0.0626	0.0655	0.0952	0.0910	0.0861
PARAFFIN/OLEFIN RATIO					
C3	0.4897	0.4770	1.1243	0.9731	0.9653
C4	0.4731	0.4573	0.7193	0.6751	0.6529
C5	0.7066	0.7048	1.2870	1.2012	1.1318
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.7699	0.8786	0.7818	0.8549	0.7828
RATIO CH4/(1-A)**2	1.1428	4.1469	2.5990	5.3607	2.2605
ALPHA FRM CORRELATION		0.8321		0.8397	
ALPHA (EXPTL/CORR)		1.0559		1.0181	
W%CH4 FRM CORRELATION		15.2991		17.5449	
W%CH4 (EXPTL/CORR)		0.3994		0.6434	
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F		376		301	
16		414		342	
50		640		540	
84		935		796	
90		1021		875	
RANGE(16-84 %)		521		454	
WT % @ 420 F	50.00	18.50	50.00	31.30	50.00
WT % @ 700 F	90.00	58.80	90.00	73.60	90.00

Table B19

FILE: 1161705C TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-05
CATALYST CO/X11-U103 250 CC 106.1 G AFTER USE:159.7 G (+53.6 G)
FEED H2:CO OF 50:50 @1260 CC/MN OR 300 GHSV (CAT#12524-9)

RUN & SAMPLE NO.	11617-05-11	617-05-12
FEED H2:CO:AR	50:50: 0	50:50: 0
HRS ON STREAM	282.0	330.5
PRESSURE,PSIG	300	300
TEMP. C	259	260
FEED CC/MIN	1260	1260
HOURS FEEDING	23.00	48.50
EFFLNT GAS LITER	885.73	1833.79
GM AQUEOUS LAYER	171.09	363.36
GM OIL	104.89	220.55
MATERIAL BALANCE		
GM ATOM CARBON %	97.07	95.46
GM ATOM HYDROGEN %	99.77	98.34
GM ATOM OXYGEN %	96.36	95.12
RATIO CHX/(H2O+CO2)	1.0211	1.0102
RATIO X IN CHX	2.3326	2.3217
USAGE H2/CO PRODT	1.7345	1.7659
FEED H2/CO FRM EFFLNT	1.0278	1.0302
RESIDUAL H2/CO RATIO	0.5425	0.5362
RATIO CO2/(H2O+CO2)	0.1535	0.1405
K SHIFT IN EFFLNT	0.0984	0.0877
SPECIFIC ACTIVITY SA	1.8053	1.6747
CONVERSION		
ON CO %	40.72	40.17
ON H2 %	68.71	68.85
ON CO+H2 %	54.91	54.72
PRDT SELECTIVITY,WT %		
CH4	10.65	10.12
C2 HC'S	2.12	2.04
C3H8	2.41	2.24
C3H6=	2.59	2.41
C4H10	2.17	2.06
C4H8=	3.23	3.17
C5H12	2.41	2.35
C5H10=	2.18	2.17
C6H14	3.36	3.29
C6H12= & CYCLO'S	1.42	1.39
C7+ IN GAS	8.05	8.24
LIQ HC'S	59.42	60.52
TOTAL	100.00	100.00
SUB-GROUPING		
C1 -C4	23.17	22.04
C5 -420 F	47.13	35.89
420-700 F	23.77	24.99
700-END PT	5.94	17.07

Table B19 (continued)

FILE: 1161705C TSS4Q1 A1

C5+-END PT	76.83	77.96
ISO/NORMAL MOLE RATIO		
C4	0.0201	0.0188
C5	0.0841	0.0865
C6	0.3993	0.3900
C4=	0.0839	0.0864
PARAFFIN/OLEFIN RATIO		
C3	0.8866	0.8857
C4	0.6500	0.6258
C5	1.0776	1.0528
SCHULZ-FLORY DISTRBTN		
ALPHA (EXP(SLOPE))	0.7711	0.8596
RATIO CH4/(1-A)**2	2.0323	5.1363
ALPHA FRM CORRELATION		0.8412
ALPHA (EXPTL/CORR)		1.0220
W%CH4 FRM CORRELATION		17.0918
W%CH4 (EXPTL/CORR)		0.5923
LIQ HC COLLECTION		
PHYS. APPEARANCE	OIL WAX	OIL WAX
DENSITY		
N, REFRACTIVE INDEX		
SIMULT'D DISTILATN		
10 WT % @ DEG F		301
16		343
50		543
84		814
90		891
RANGE(16-84 %)		471
WT % @ 420 F	50.00	30.50
WT % @ 700 F	90.00	71.80

X. Run 43 (12570-01) with Catalyst 43 ($Co/X_{11}/TC-103$)

In this run an attempt was made to replicate the favorable results first obtained with Catalyst 32 (Run 12200-19, Third Quarterly Report). The catalyst was prepared in exactly the same way as Catalyst 32 and contained the same theoretical concentrations of cobalt and X_{11}, 8.2 and 1.6 percent respectively.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. B167-170. Simulated distillations of the C_5+ product are plotted in Figs. B170-177. Carbon number product distributions are plotted in Figs. B178-184. Chromatograms from simulated distillations are reproduced in Figs. B185-191. Detailed material balances appear in Tables B20-22.

The results in general closely resembled those obtained with Catalyst 32. At 240C, in both runs, the $CO+H_2$ conversion was in the low to middle 40 percent range, methane production was about 5 percent, and there was a large deviation in conversion levels due to high wax production. Both the short duration of the run at 240C, and the wide fluctuations of the data points, preclude any reliable estimate of catalyst stability.

When the temperature was raised to 260C the conversion increased in both runs to about 56 percent. After about 100 hours at 260C, however, the conversion of this catalyst had fallen to

52 percent, whereas that of Catalyst 32 had risen slightly to about 57 percent.

By linear least squares analysis of the last four samples, the conversion of this catalyst decreased at a rate of one percentage point every 100 hours. While the duration of the run was again too short for reliable estimates of stability, qualitatively it appears that this catalyst was not as stable as Catalyst 32.

As to selectivity, at 260C the product of this catalyst was a little lighter than that of Catalyst 32, including 10 percent methane versus 9 percent, and 78 percent C_5^+ versus 80 percent. The differences may be due to a higher residual H_2:CO ratio in the reactor due to the lower $CO+H_2$ conversion.

This run has succeeded in large part in replicating the excellent results obtained with Catalyst 32, the only exception being a slight deterioration at 260C.

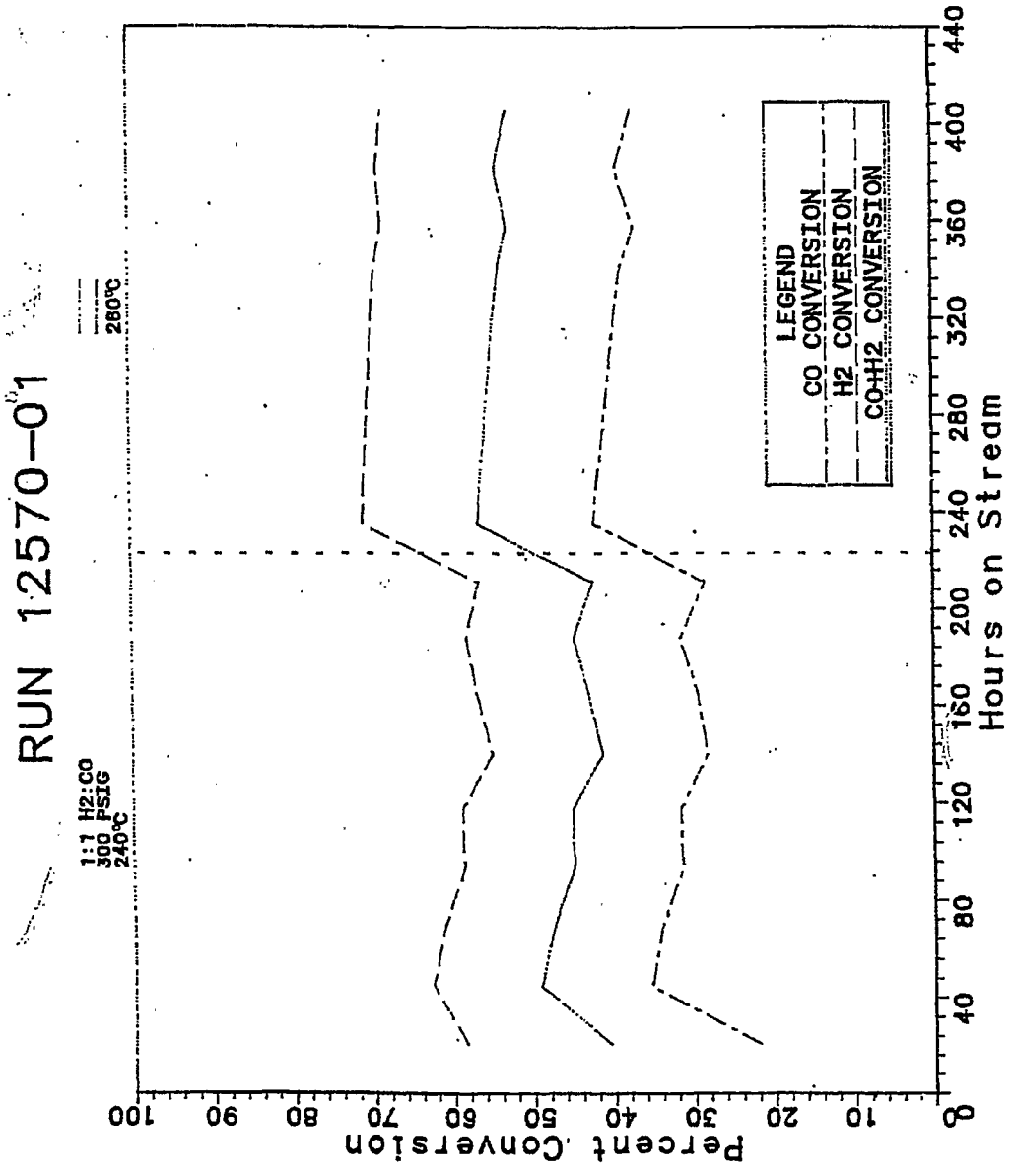

RUN 12570-01
1:1 H2:CO
300 PSIG
240°C
280°C
LEGEND
CO CONVERSION
H2 CONVERSION
CO+H2 CONVERSION
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
40
80
120
160
200
240
280
320
360
400
440

Fig. B167

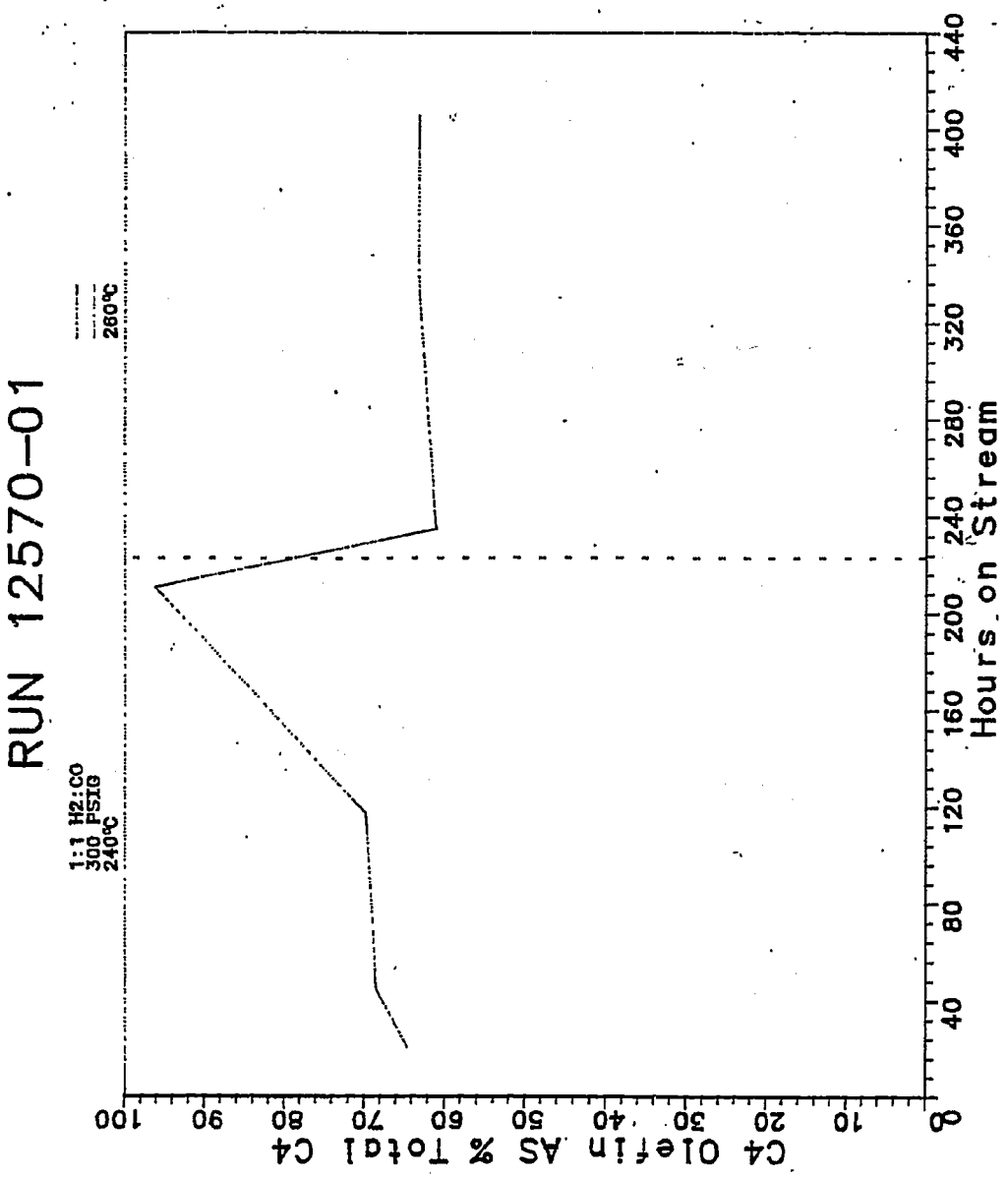

RUN 12570-01
1:1 H2:CO
300 PSIG
240°C
260°C
C4 Olefin As % Total C4
Hours on Stream
0
40
80
120
160
200
240
280
320
360
400
440
10
20
30
40
50
60
70
80
90
100

Fig. B168

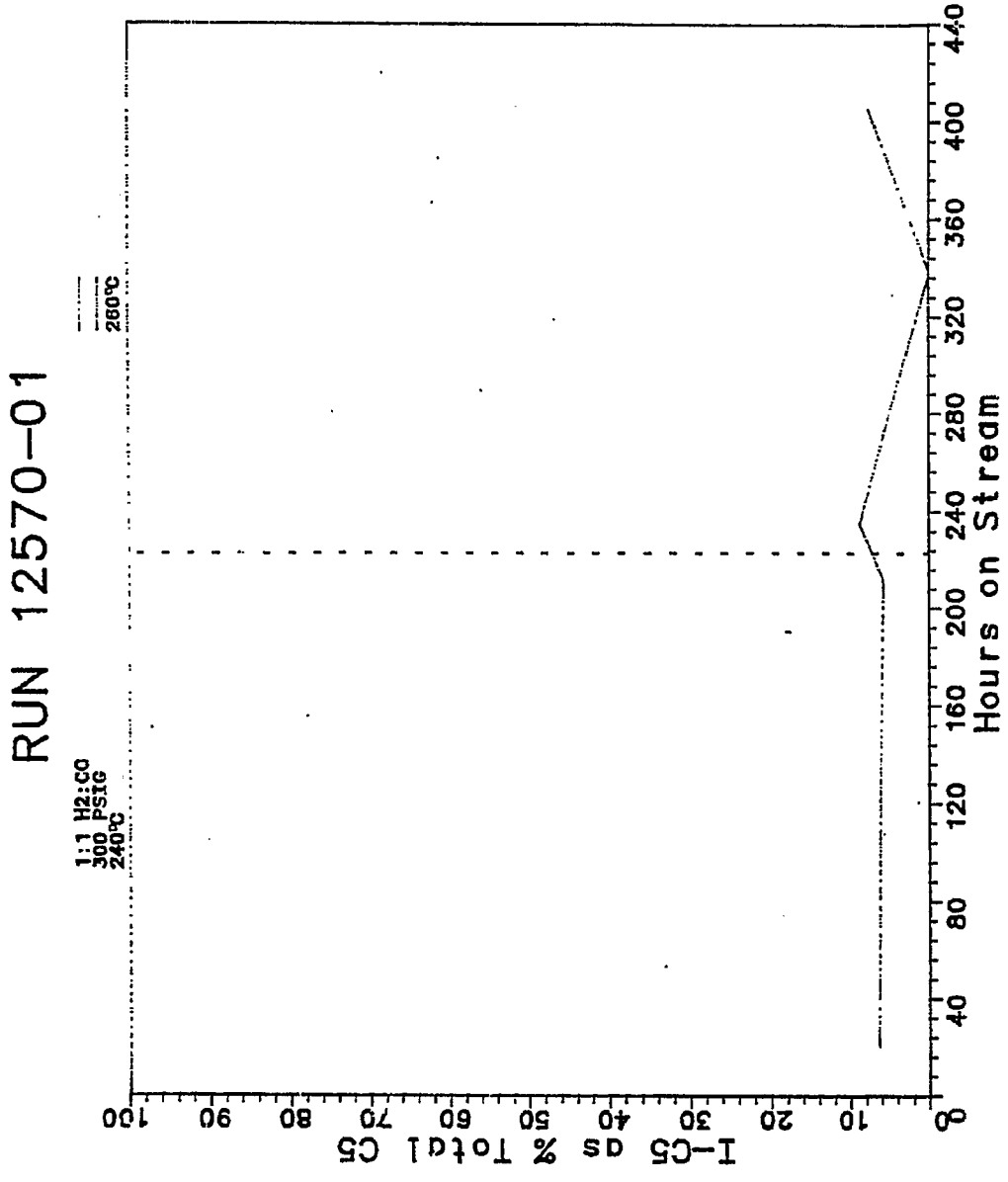

RUN 12570-01
1:1 H2:CO
300 PSIG
240°C
260°C
I-C5 gas % Total C5
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
40
80
120
160
200
240
280
320
360
400
440

Fig. B169

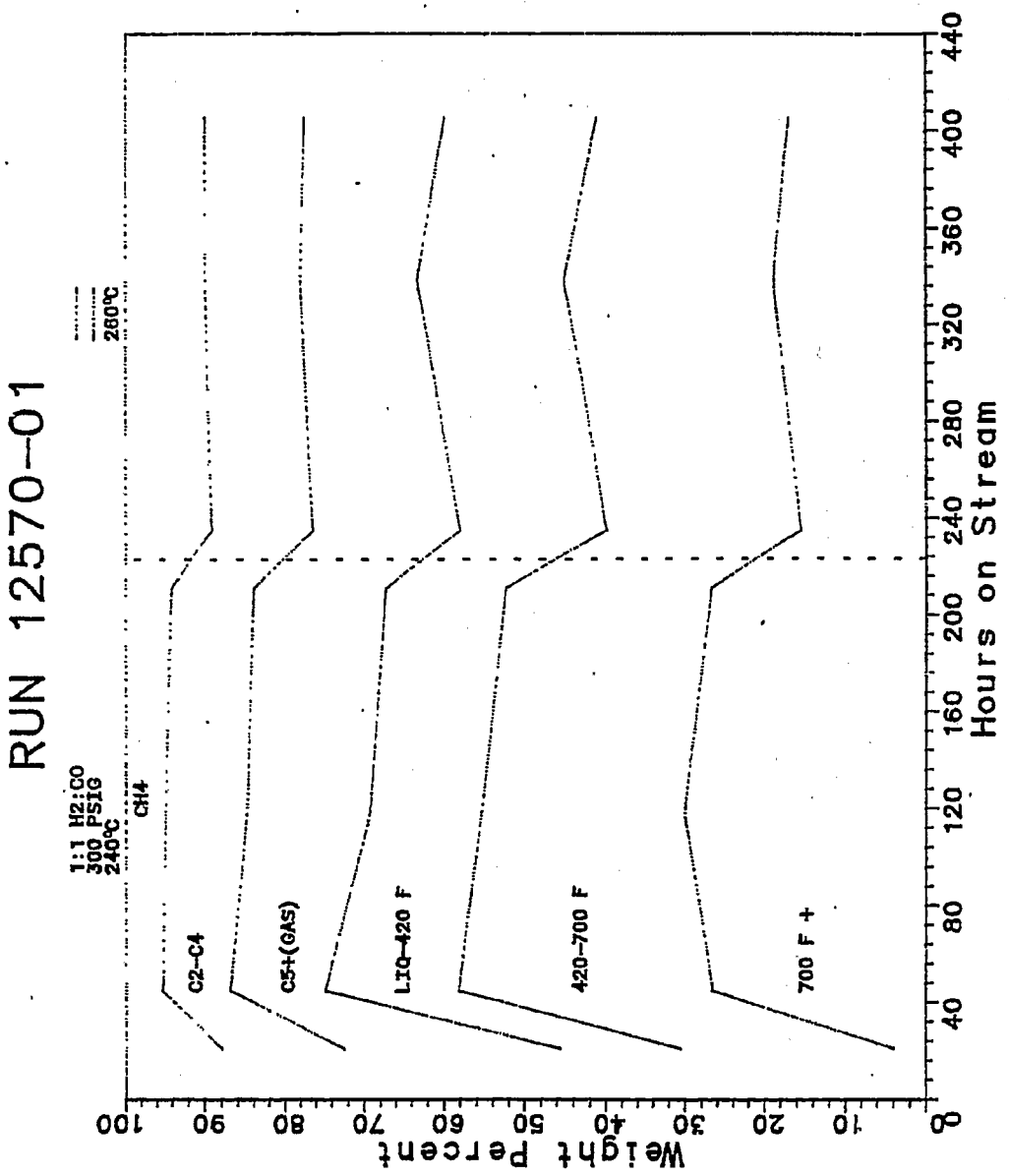

RUN 12570-01
1:1 H2:CO
300 PSIG
240°C
280°C
CH4
C2-C4
C5+(GAS)
LIQ-420 F
420-700 F
700 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
40
80
120
160
200
240
280
320
360
400
440

Fig. B170

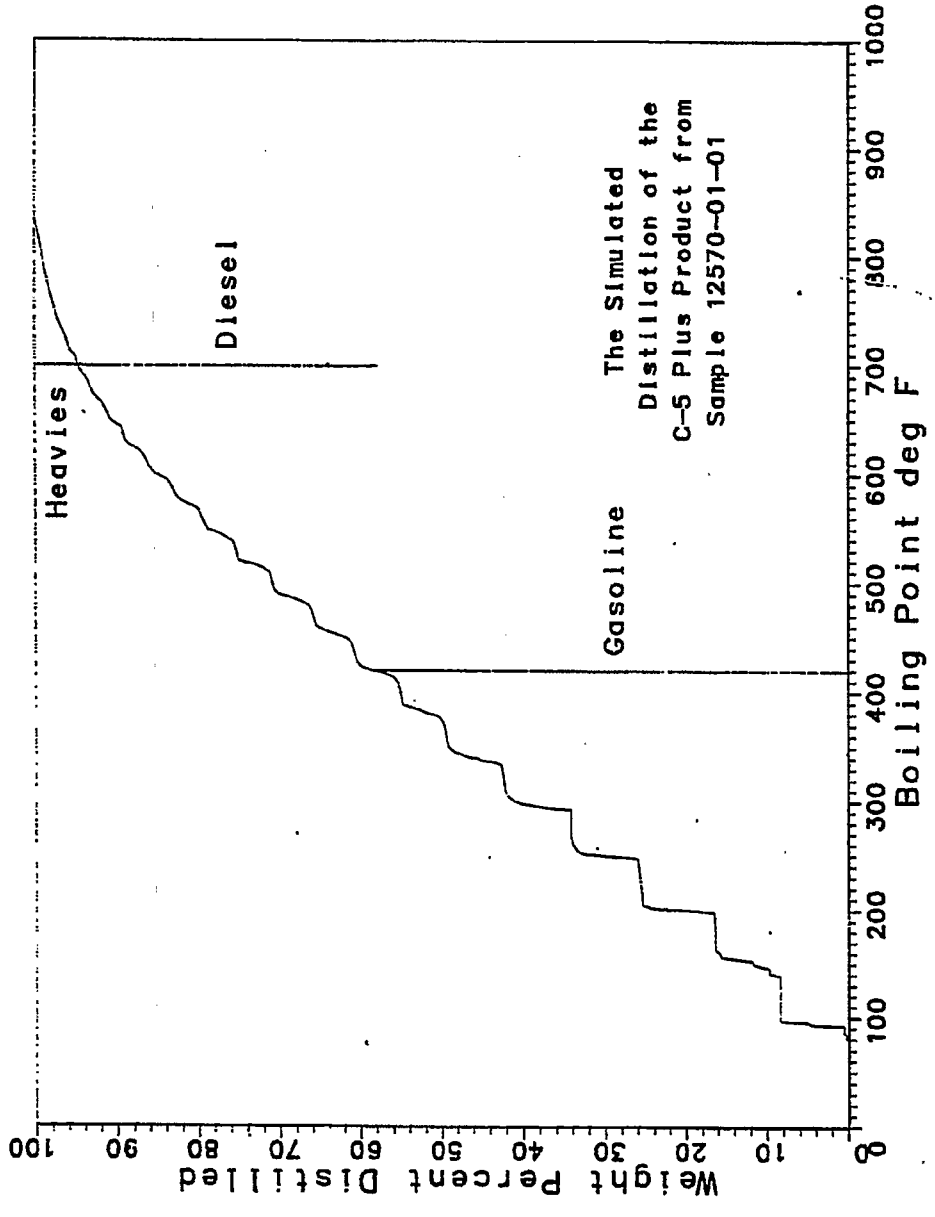

Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point deg F
0
100
200
300
400
500
600
700
800
900
1000
Heavies
Diesel
Gasoline
The Simulated
Distillation of the
C-5 Plus Product from
Sample 12570-01-01

Fig. B171

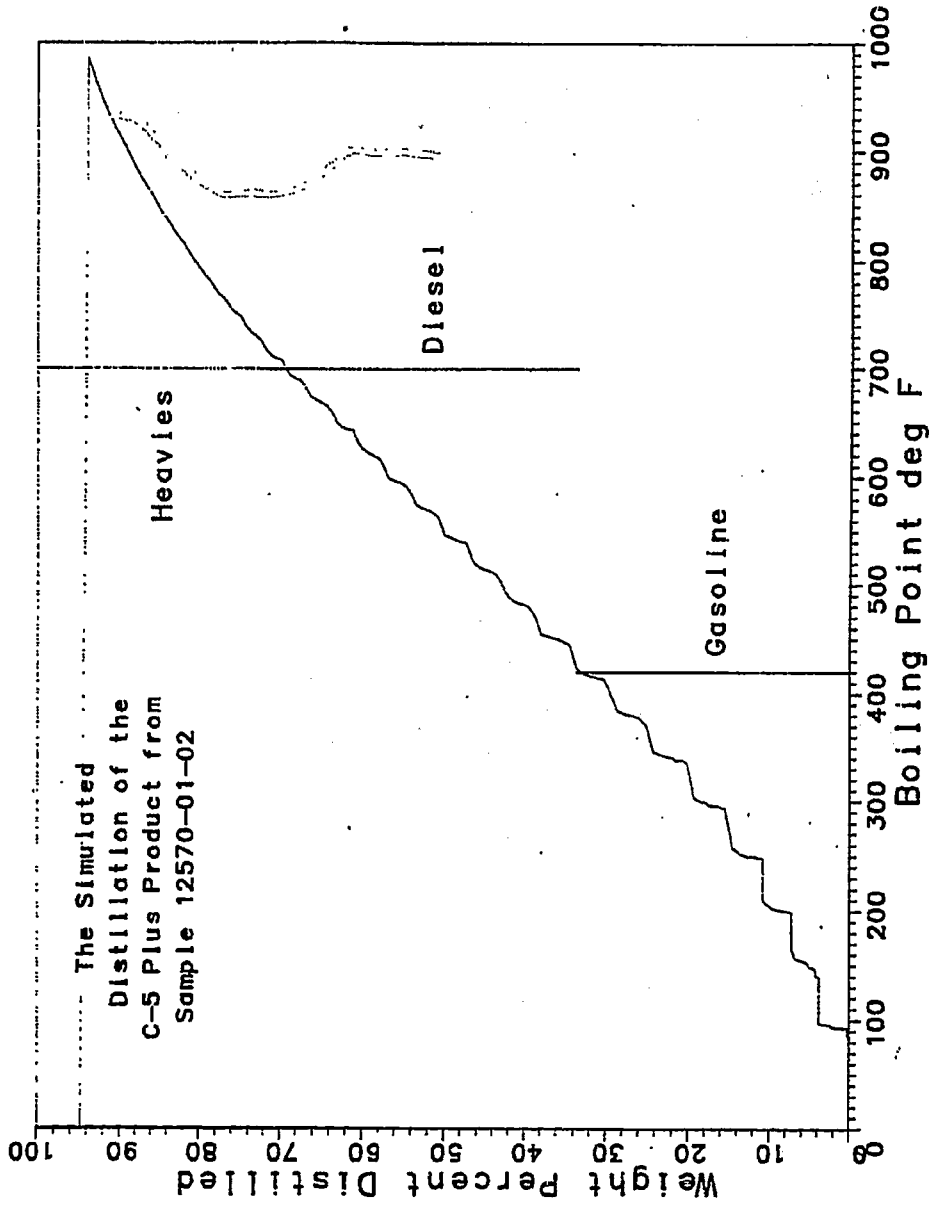

Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point deg F
100
200
300
400
500
600
700
800
900
1000
Gasoline
Diesel
Heavies
The Simulated Distillation of the C-5 Plus Product from Sample 12570-01-02

Fig. B172

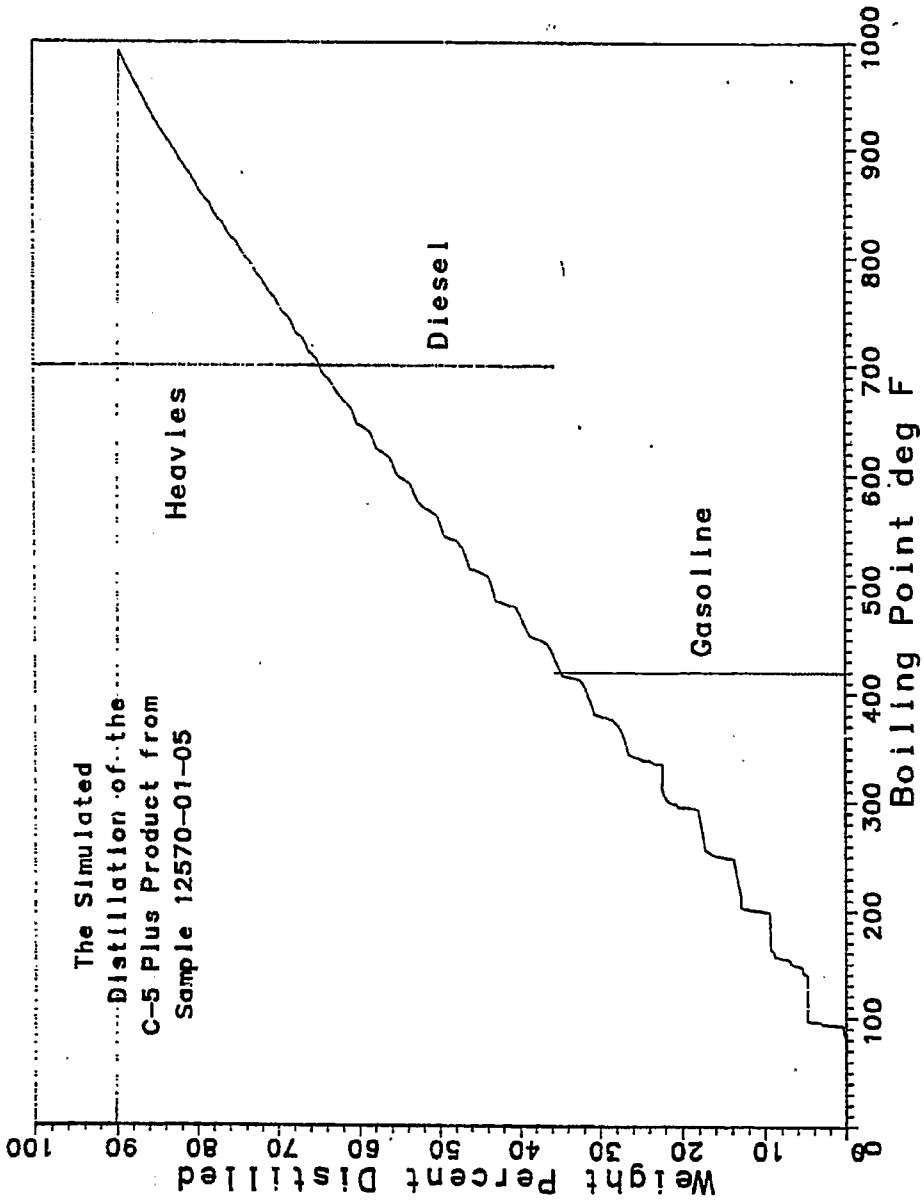

The Simulated Distillation of the C-5 Plus Product from Sample 12570-01-05
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B173

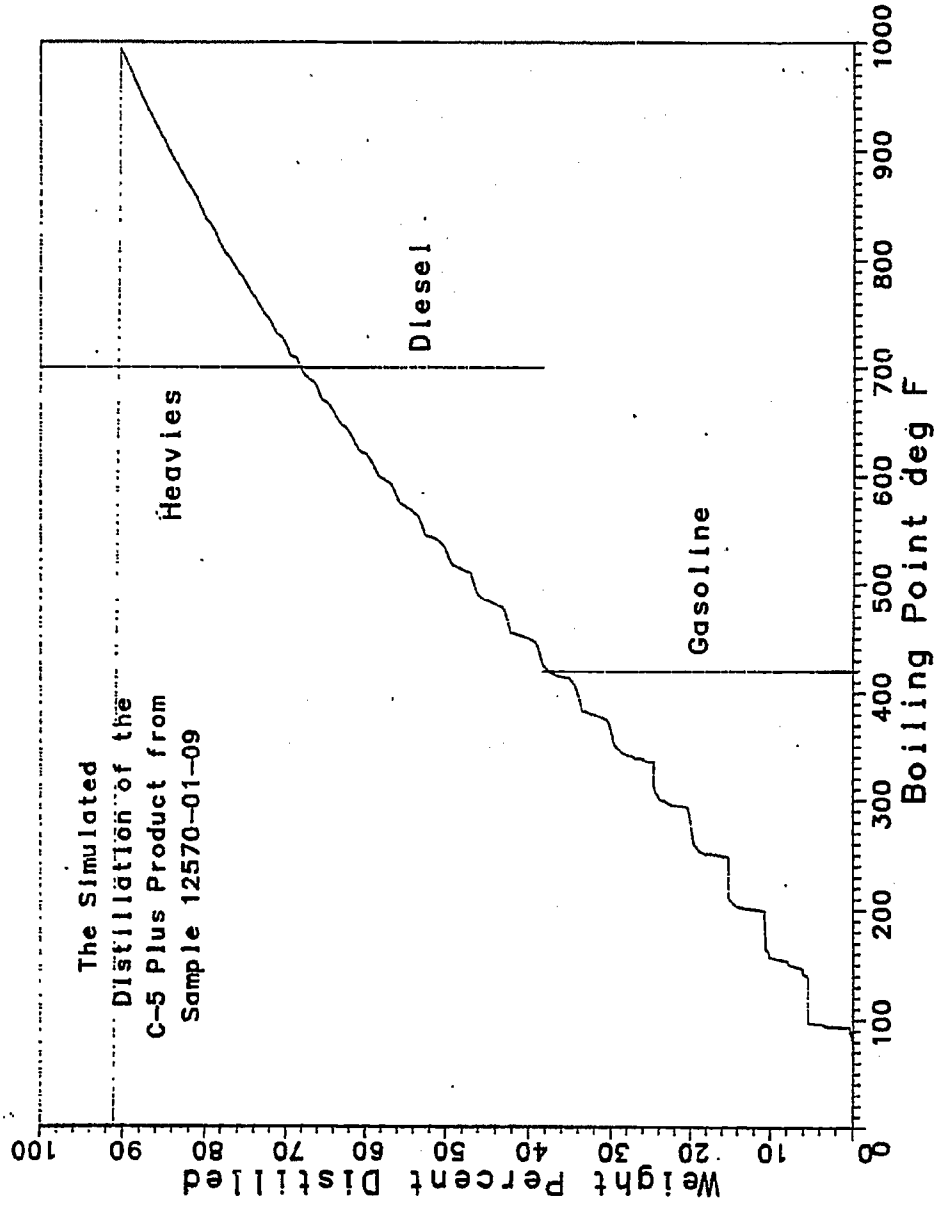

The Simulated
Distillation of the
C-5 Plus Product from
Sample 12570-01-09
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

Fig. B174

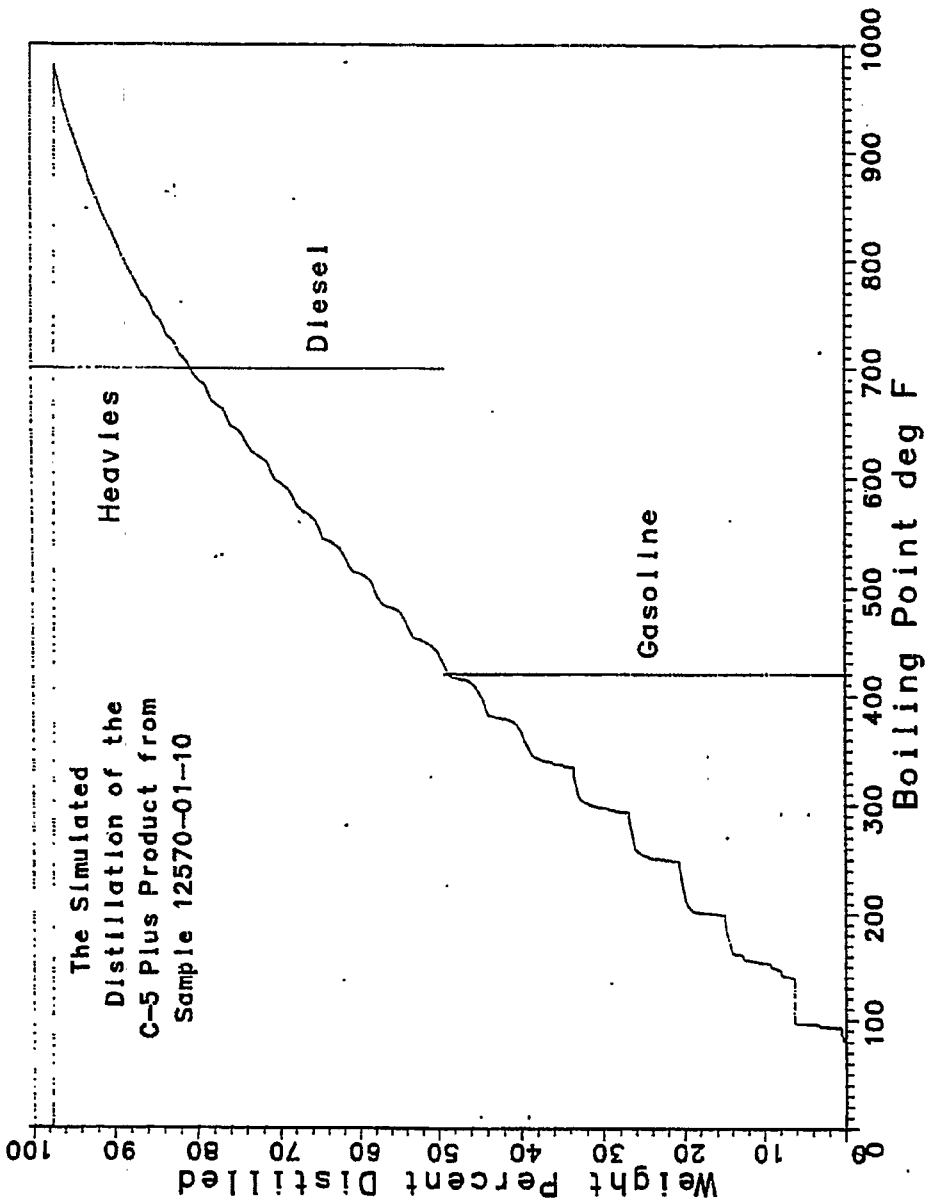

The Simulated
Distillation of the
C-5 Plus Product from
Sample 12570-01-10
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B175

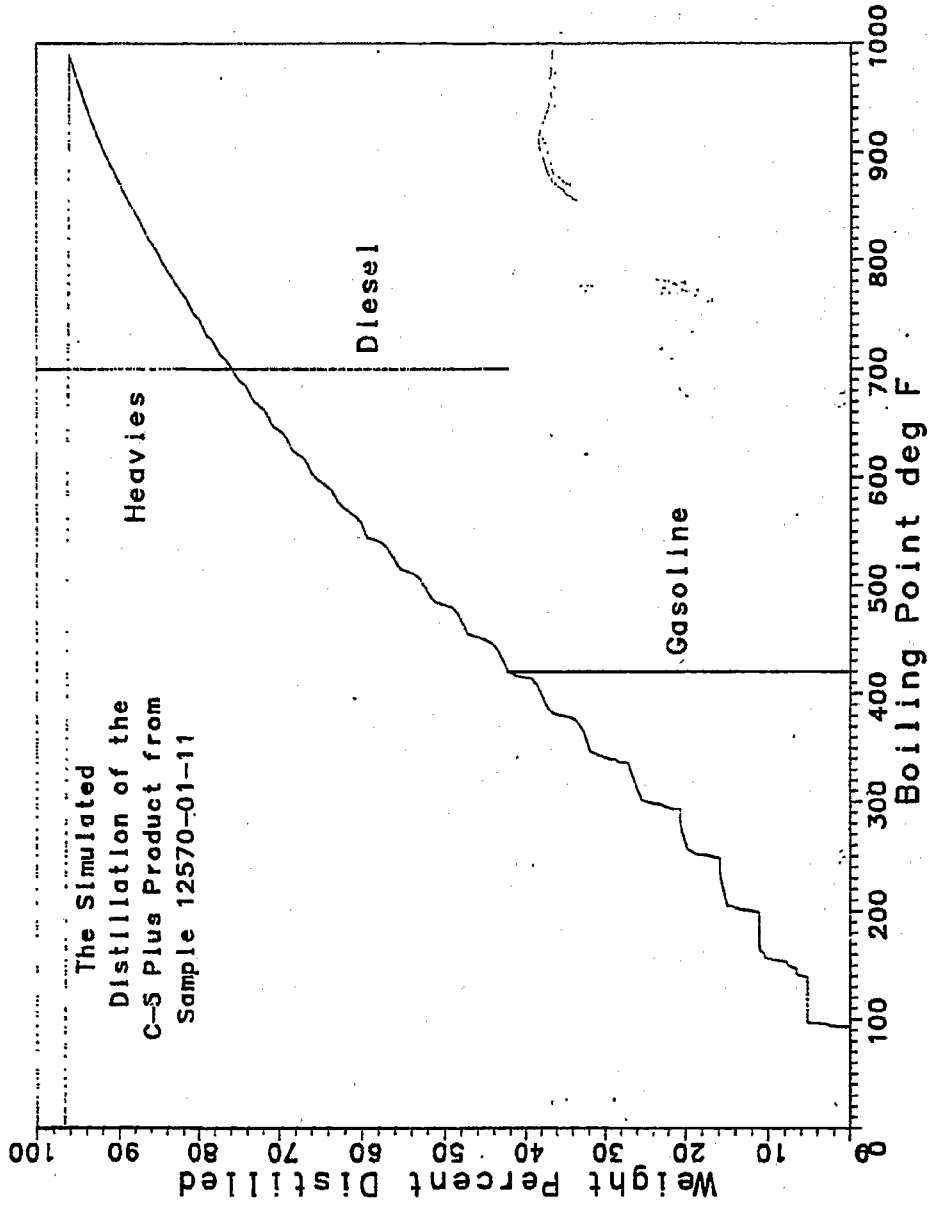

The Simulated
Distillation of the
C-5 Plus Product from
Sample 12570-01-11
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B176

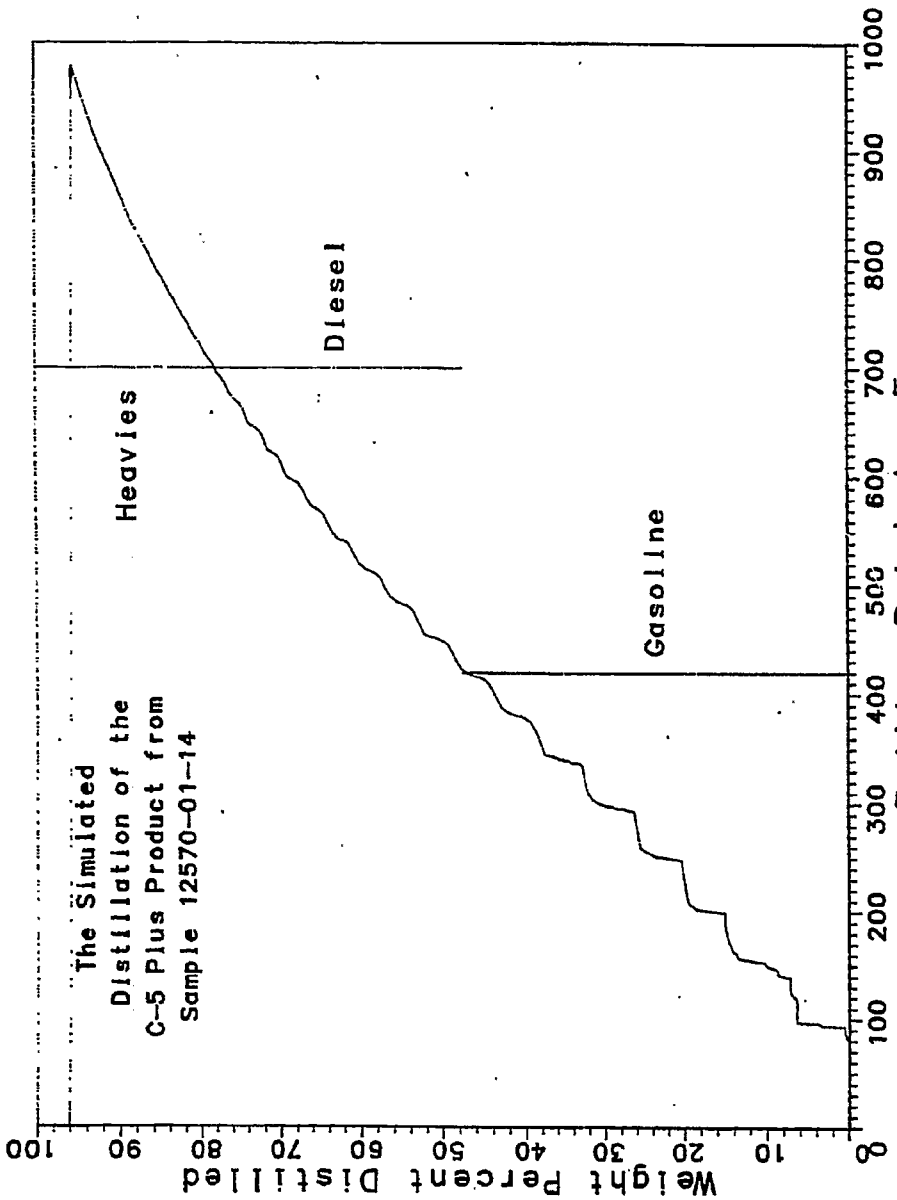

The Simulated
Distillation of the
C-5 Plus Product from
Sample 12570-01-14
Heavies
Diesel
Gasoline
Weight Percent Distilled
Boiling Point deg F
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400
500
600
700
800
900
1000

Fig. B177

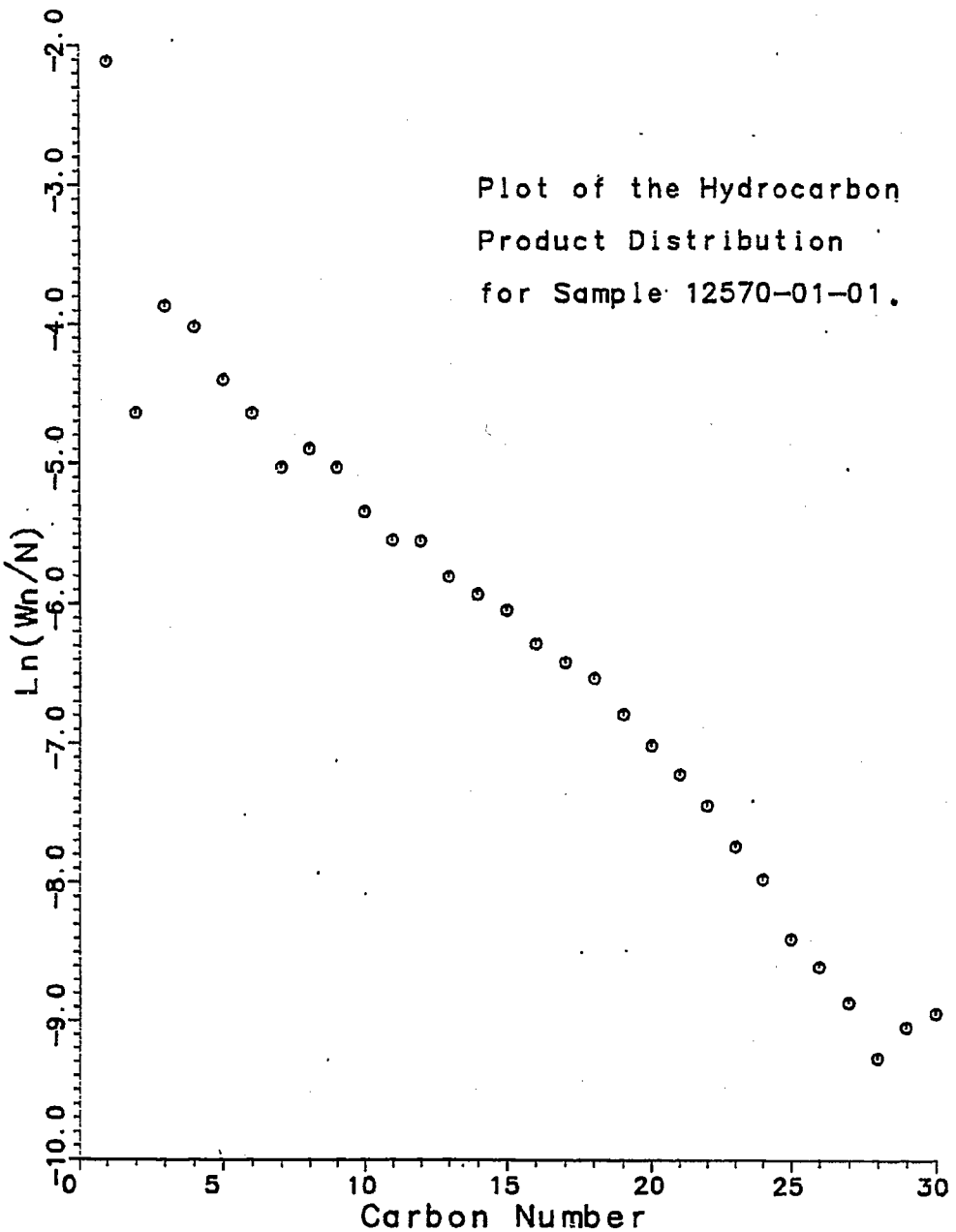

Plot of the Hydrocarbon
Product Distribution
for Sample 12570-01-01.
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
Carbon Number

Fig. B178

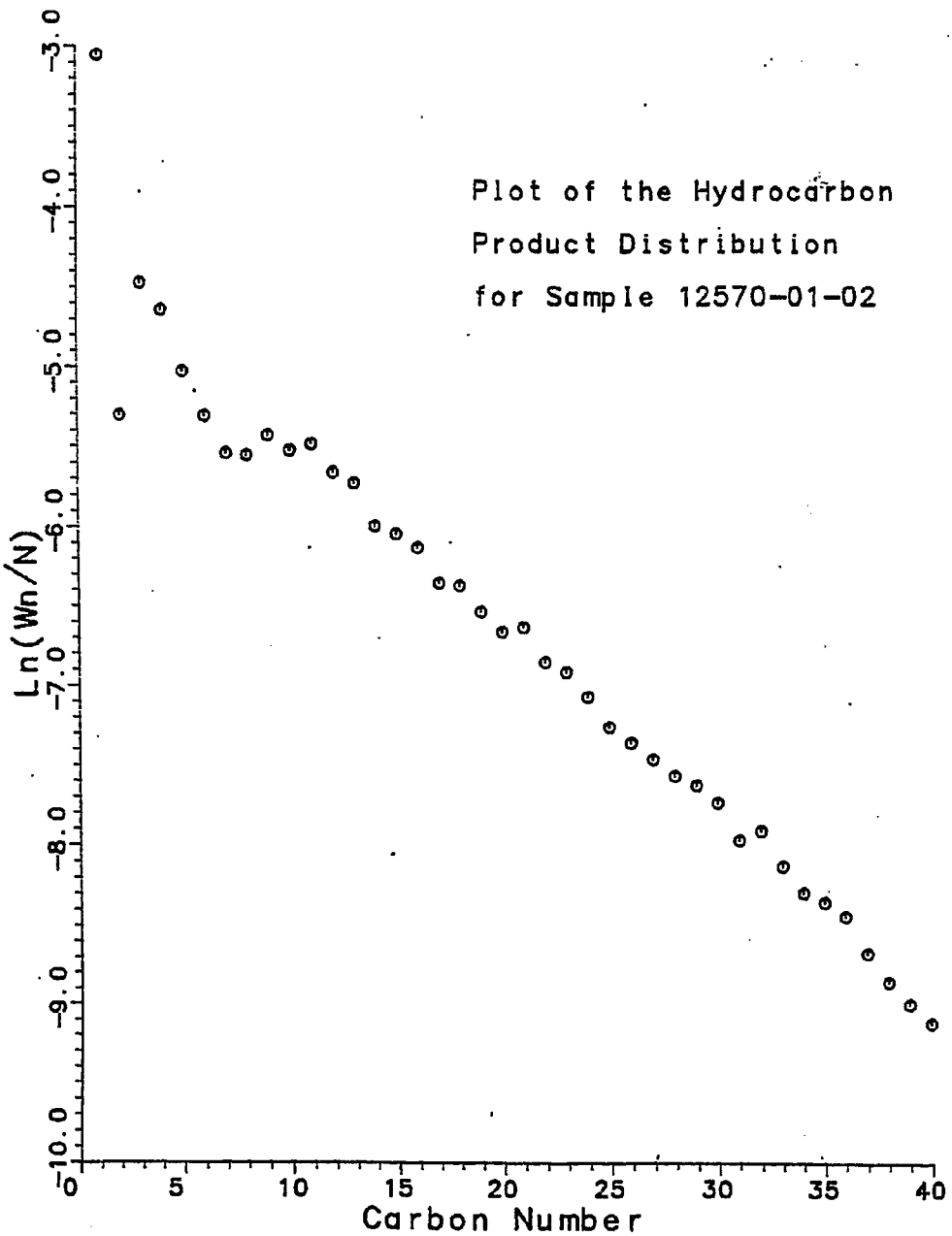

Plot of the Hydrocarbon
Product Distribution
for Sample 12570-01-02
Ln(Wn/N)
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B179

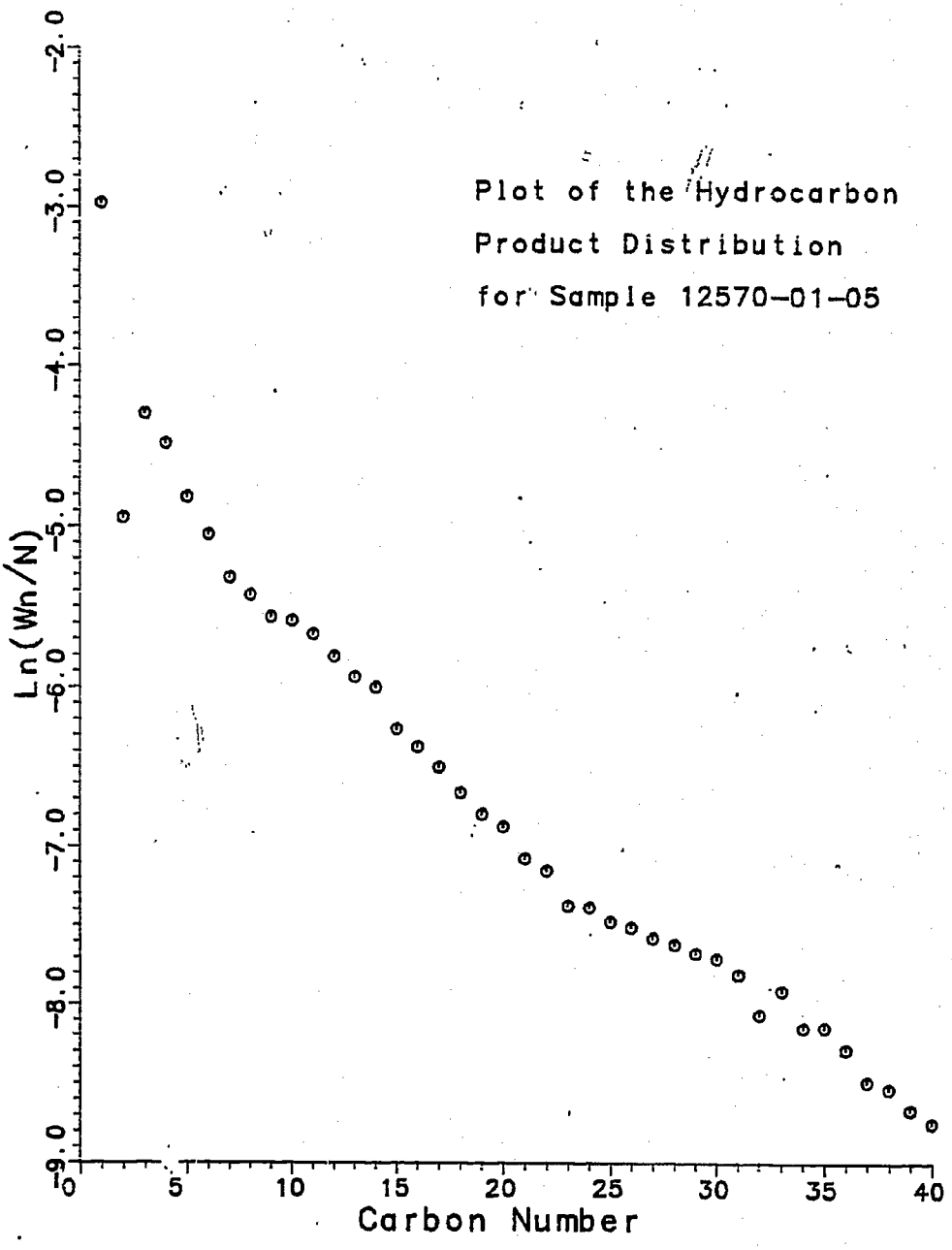

Plot of the Hydrocarbon
Product Distribution
for Sample 12570-01-05
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B180

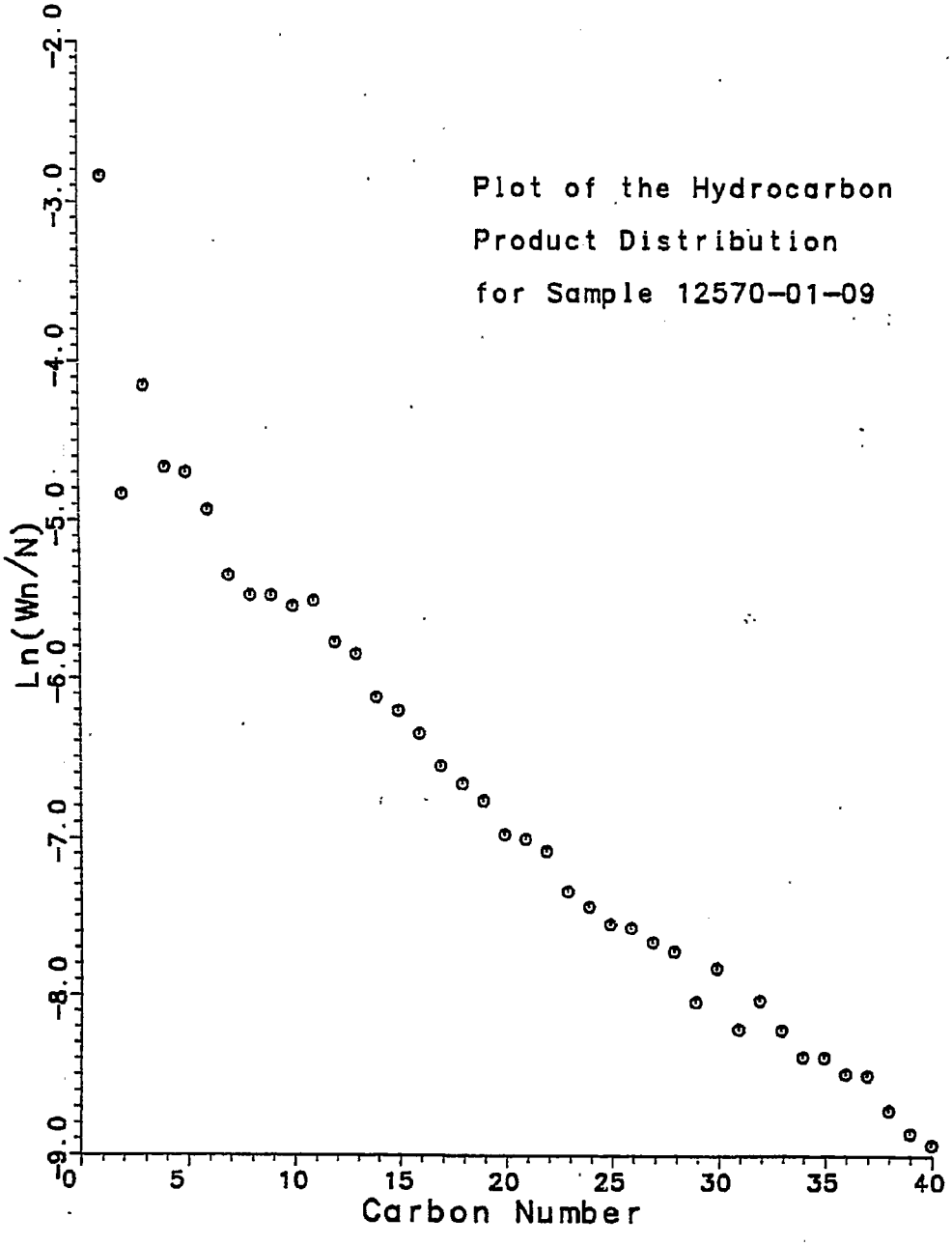

Plot of the Hydrocarbon
Product Distribution
for Sample 12570-01-09
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B181

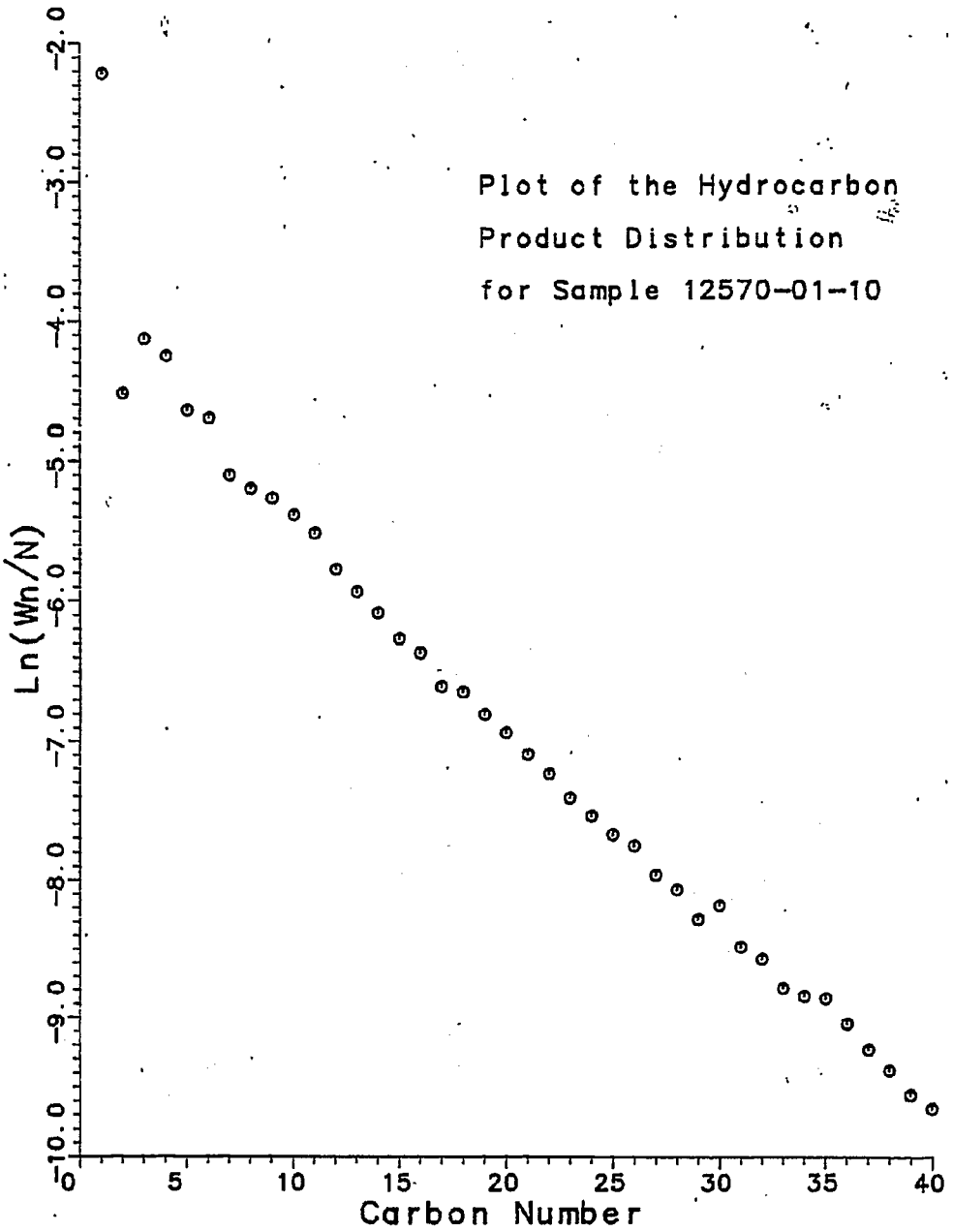

Plot of the Hydrocarbon
Product Distribution
for Sample 12570-01-10
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B182

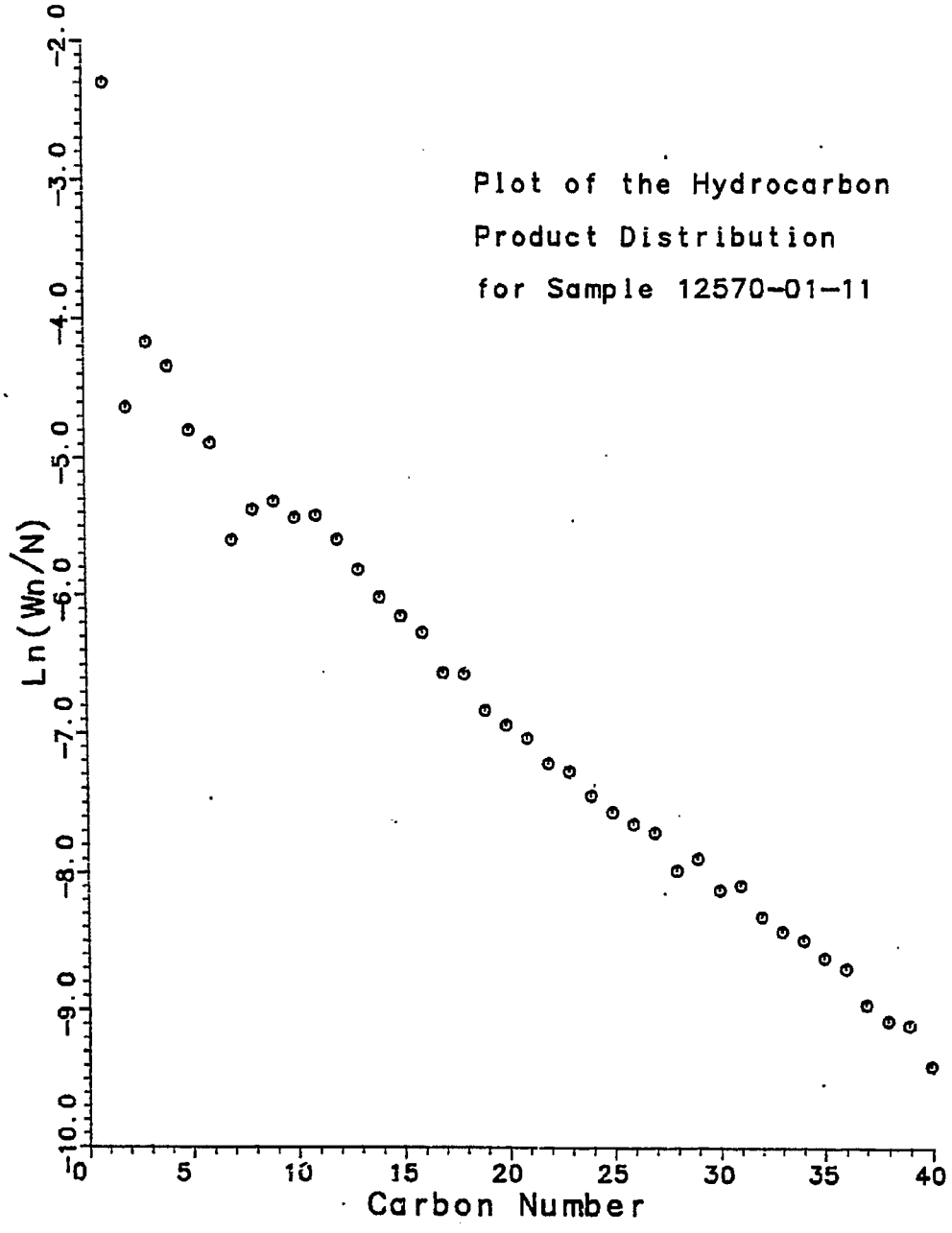

Plot of the Hydrocarbon
Product Distribution
for Sample 12570-01-11
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B183

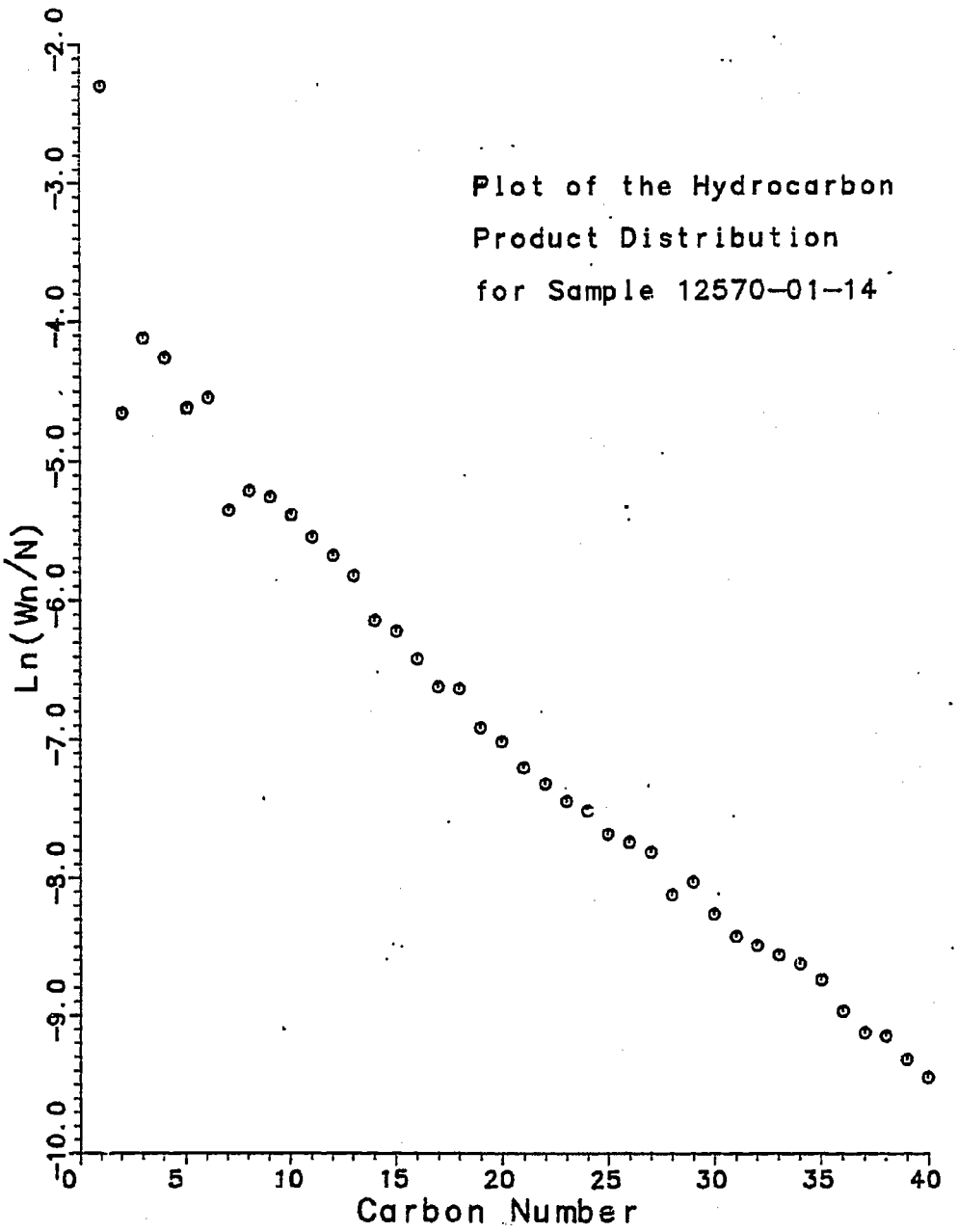
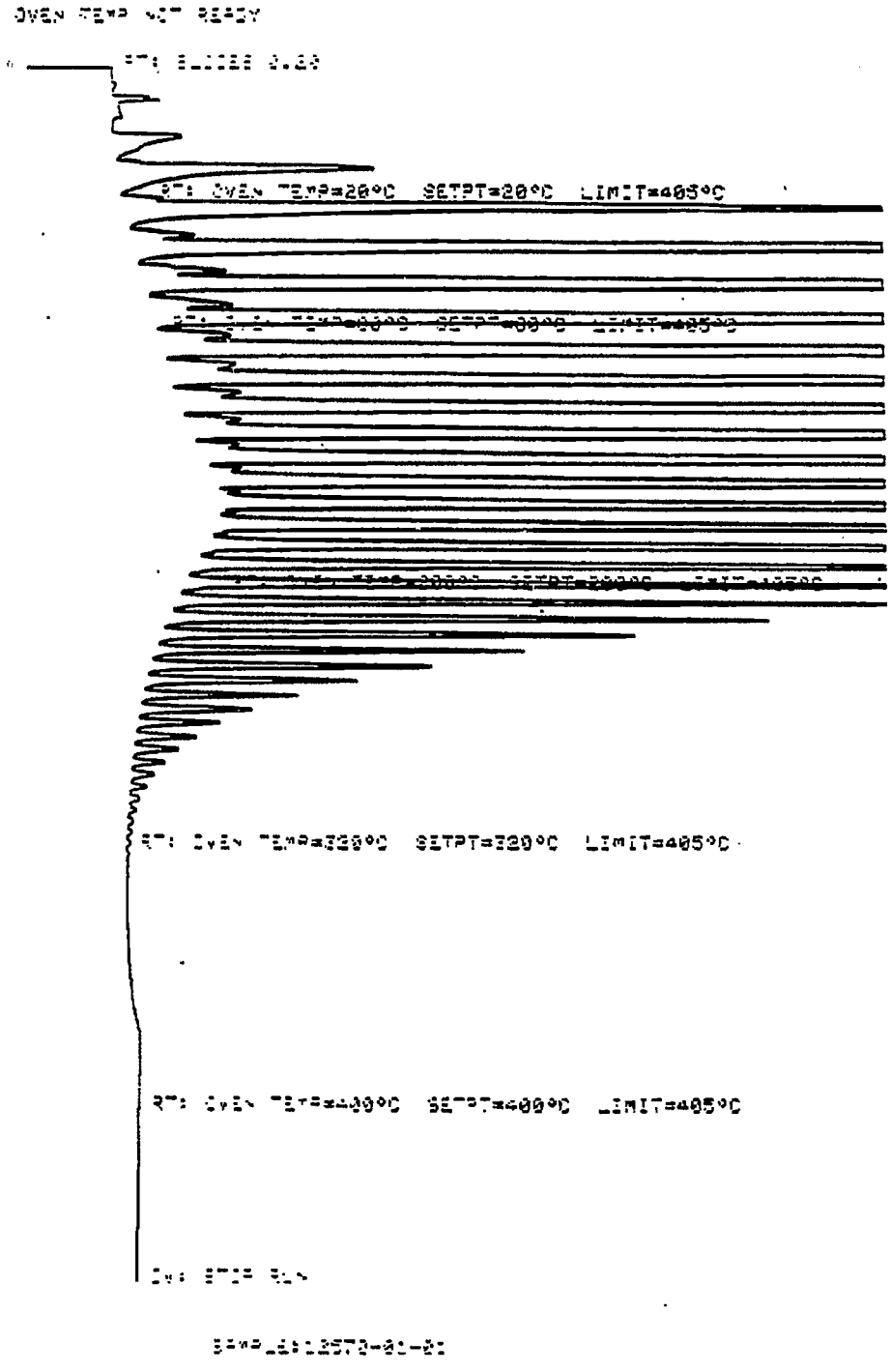

Plot of the Hydrocarbon
Product Distribution
for Sample 12570-01-14
Ln(Wn/N)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. B184


OVEN TEMP SET READY
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RT: OVEN TEMP=220°C SETPT=220°C LIMIT=405°C
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Fig. B185

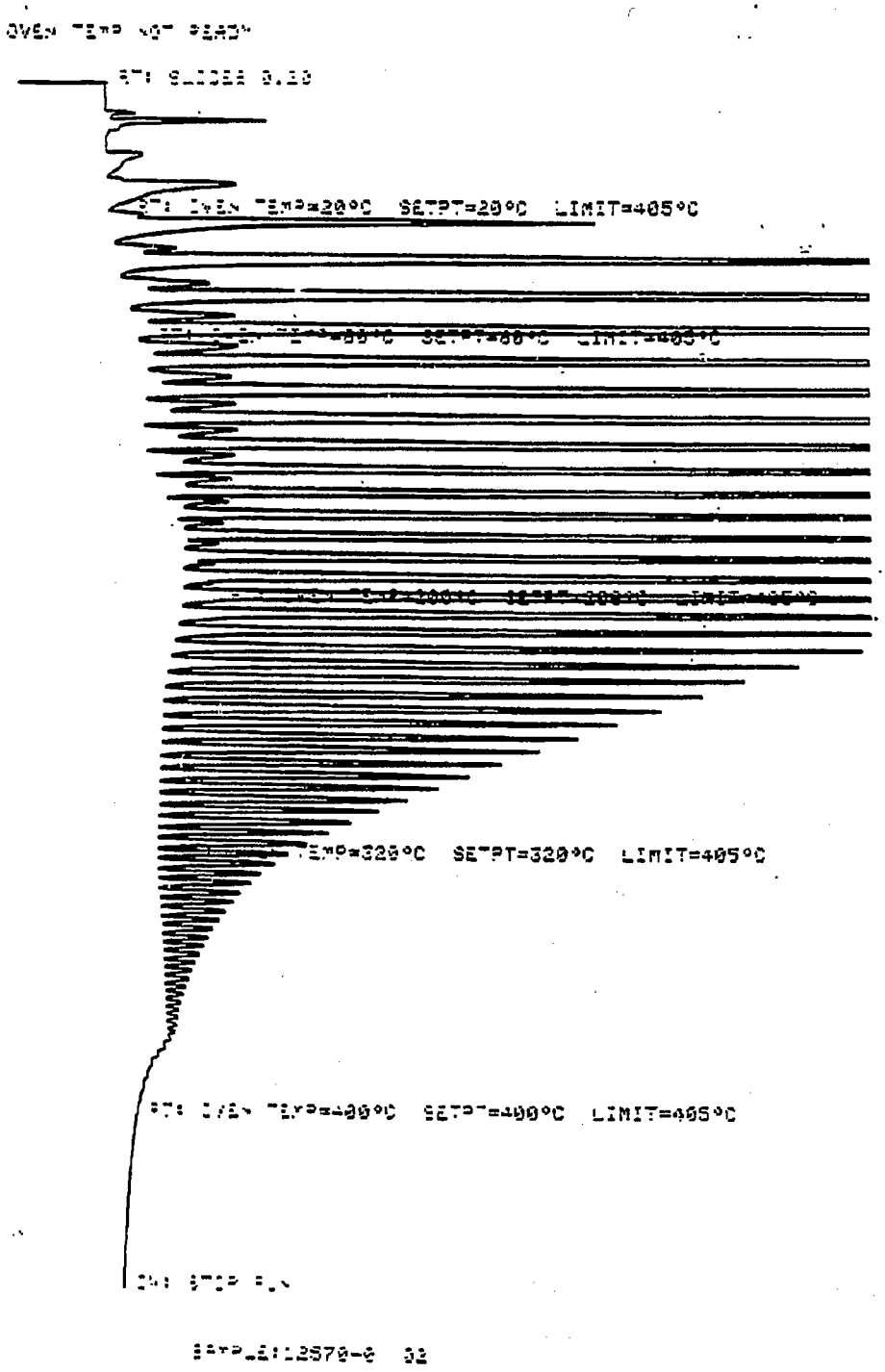

Fig. B186

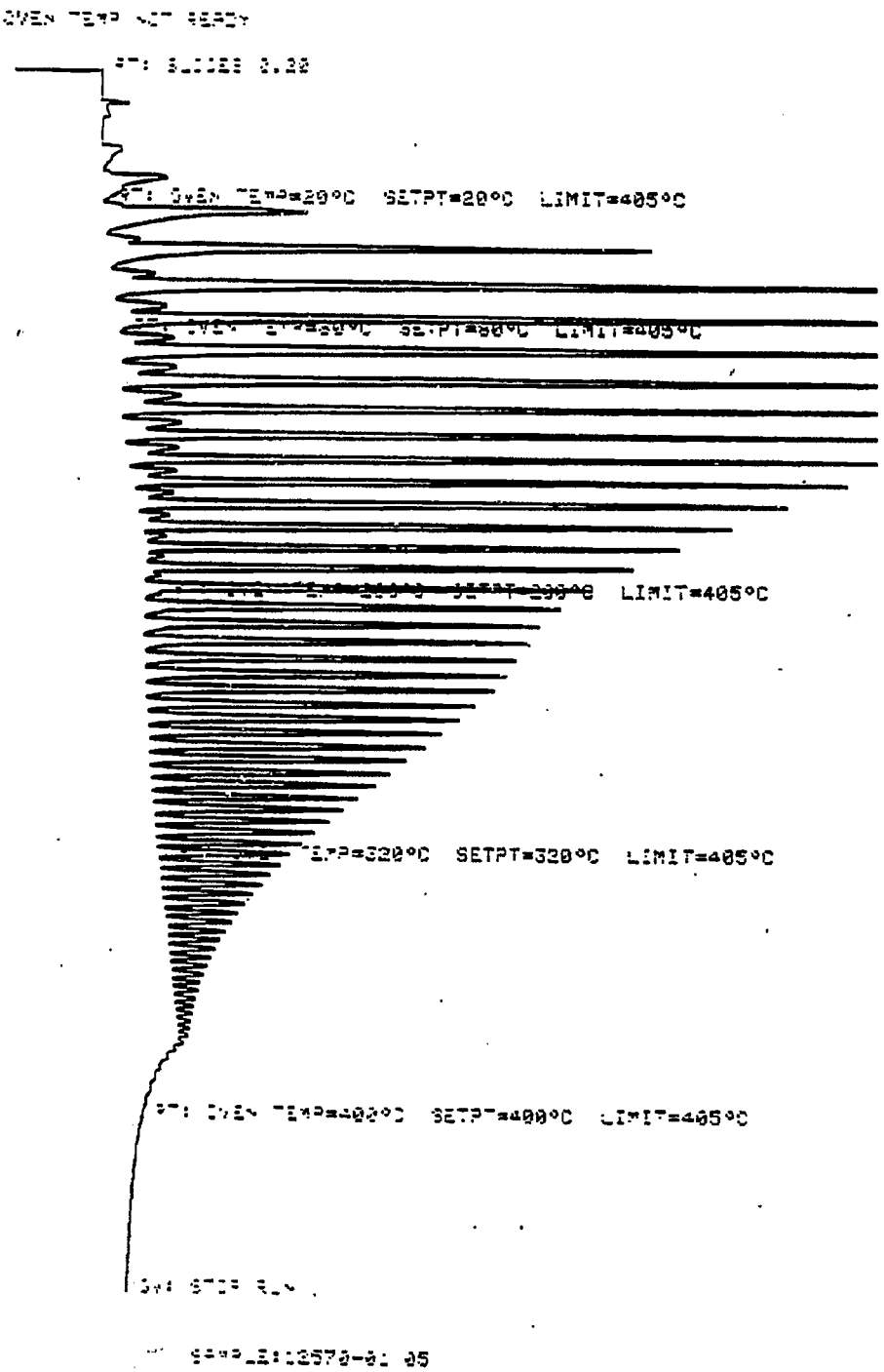
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Fig. B187

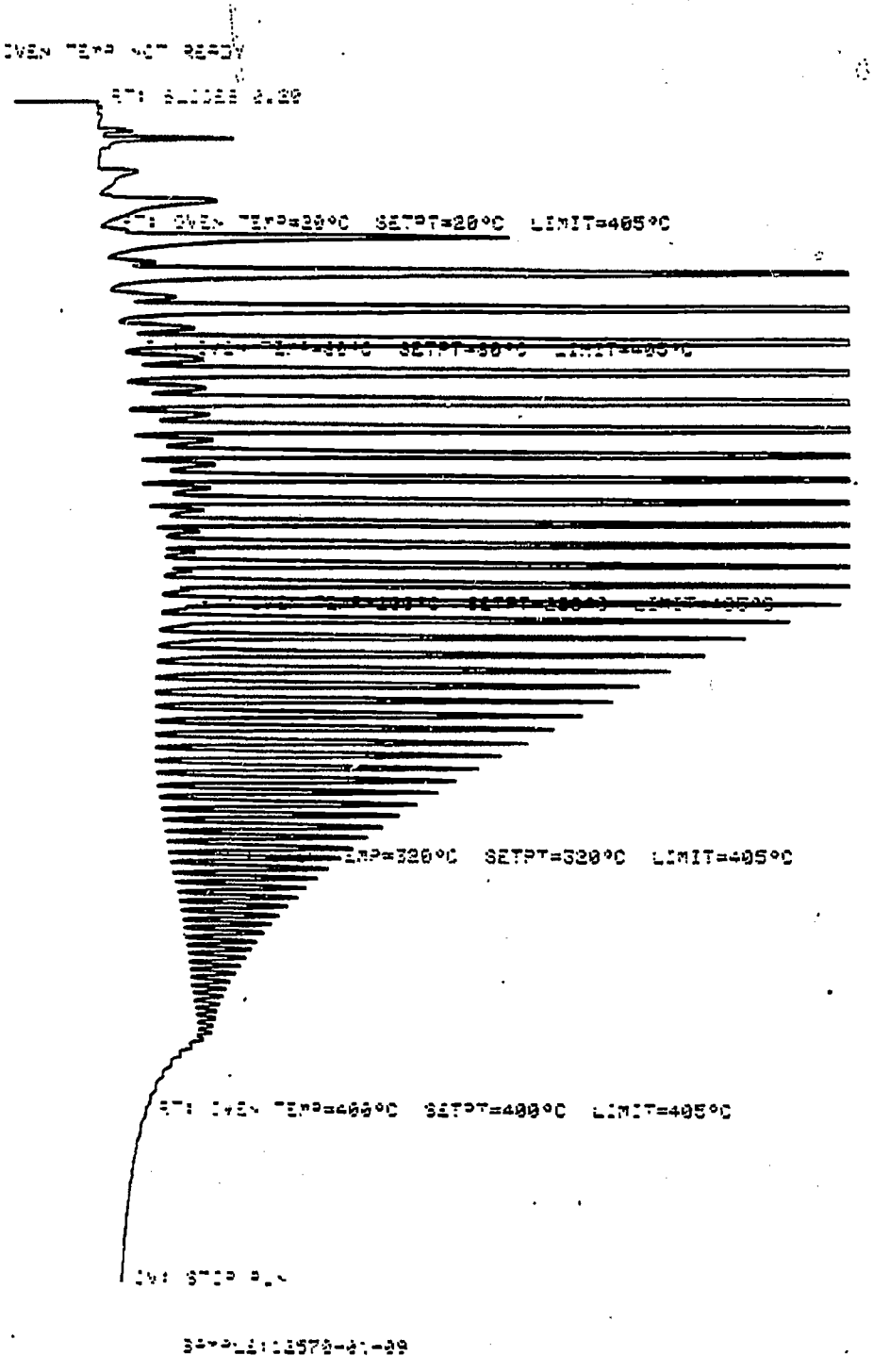
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Fig. B188

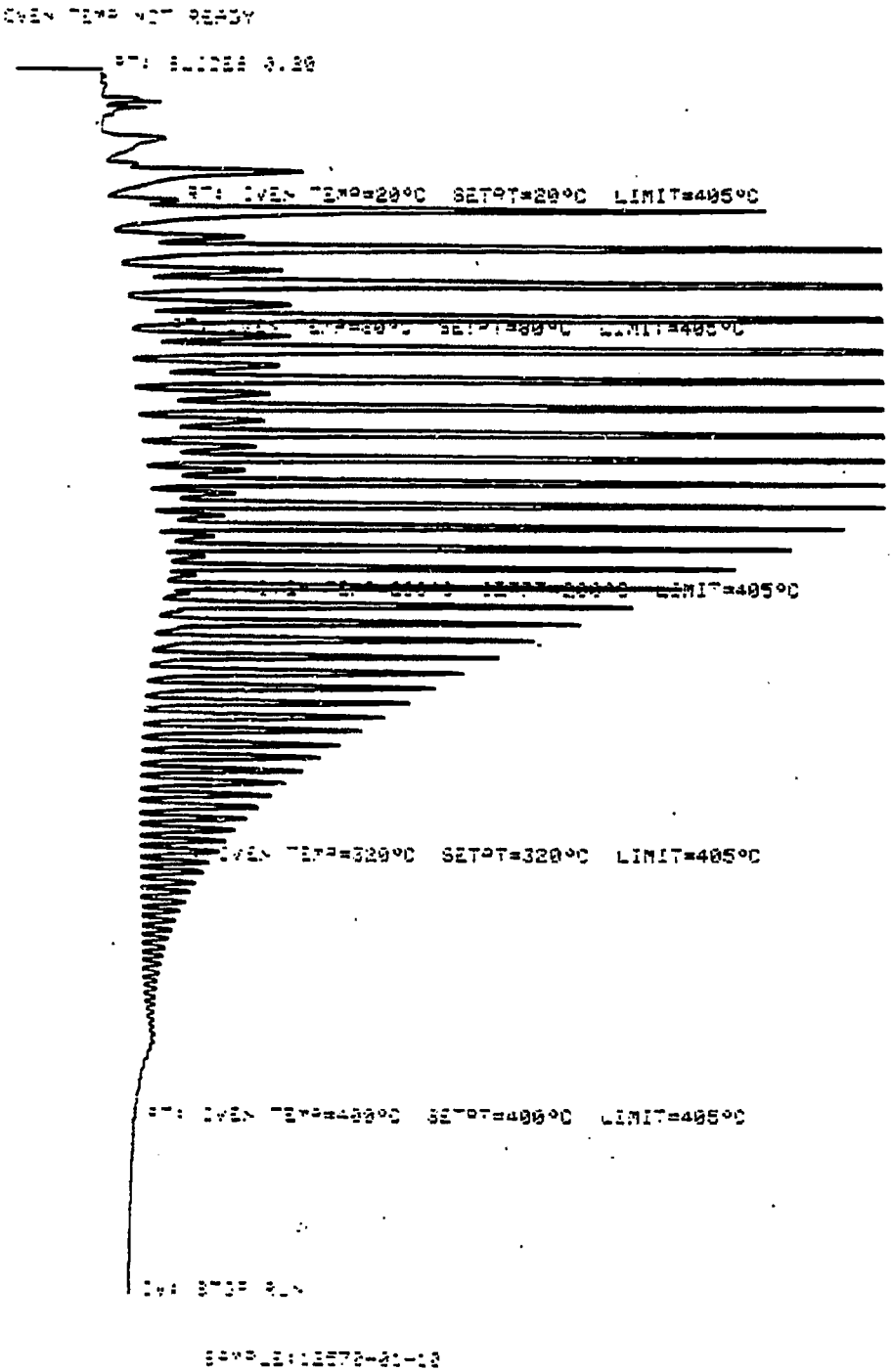
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Fig. B189

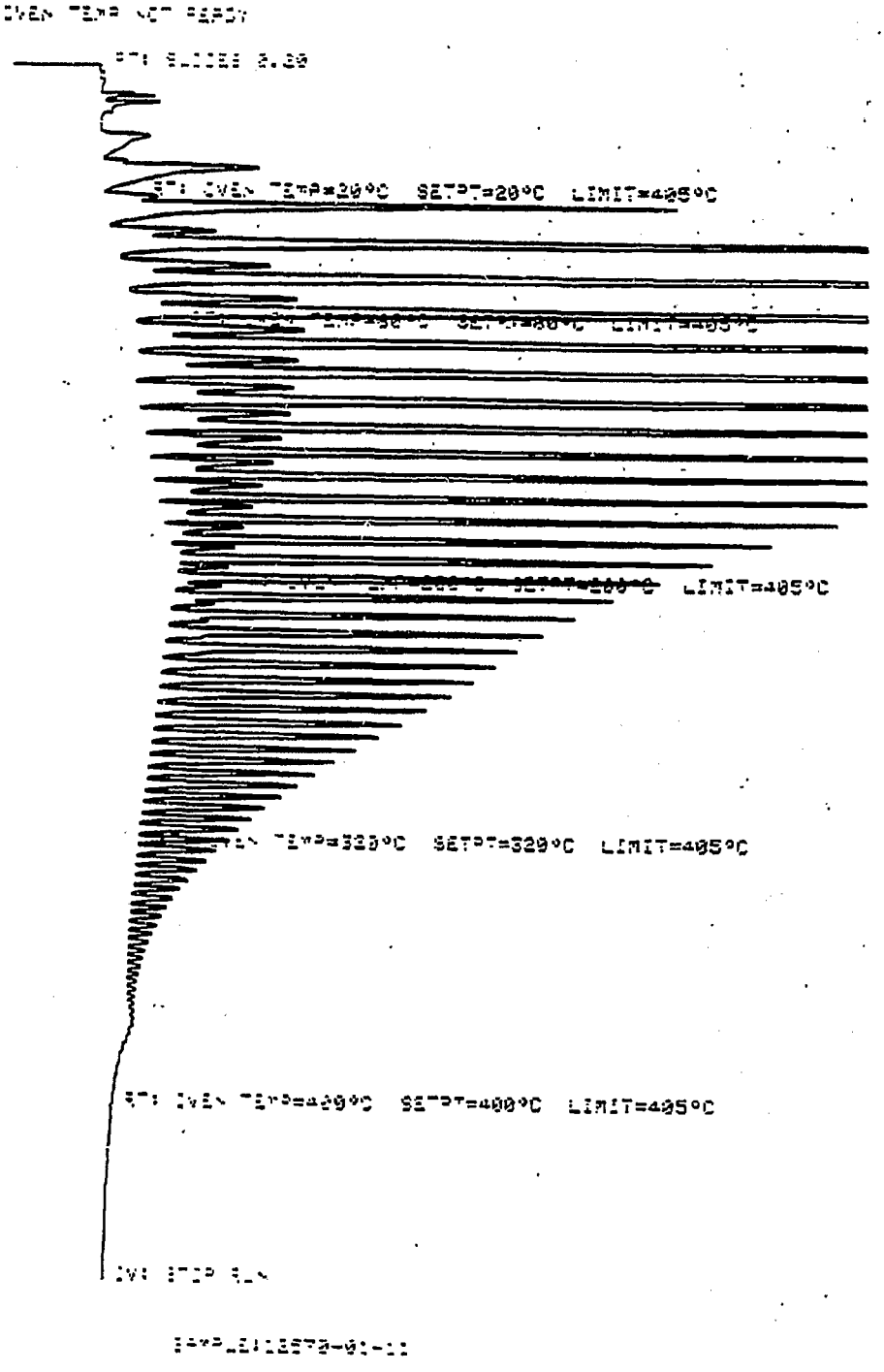
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Fig. B190

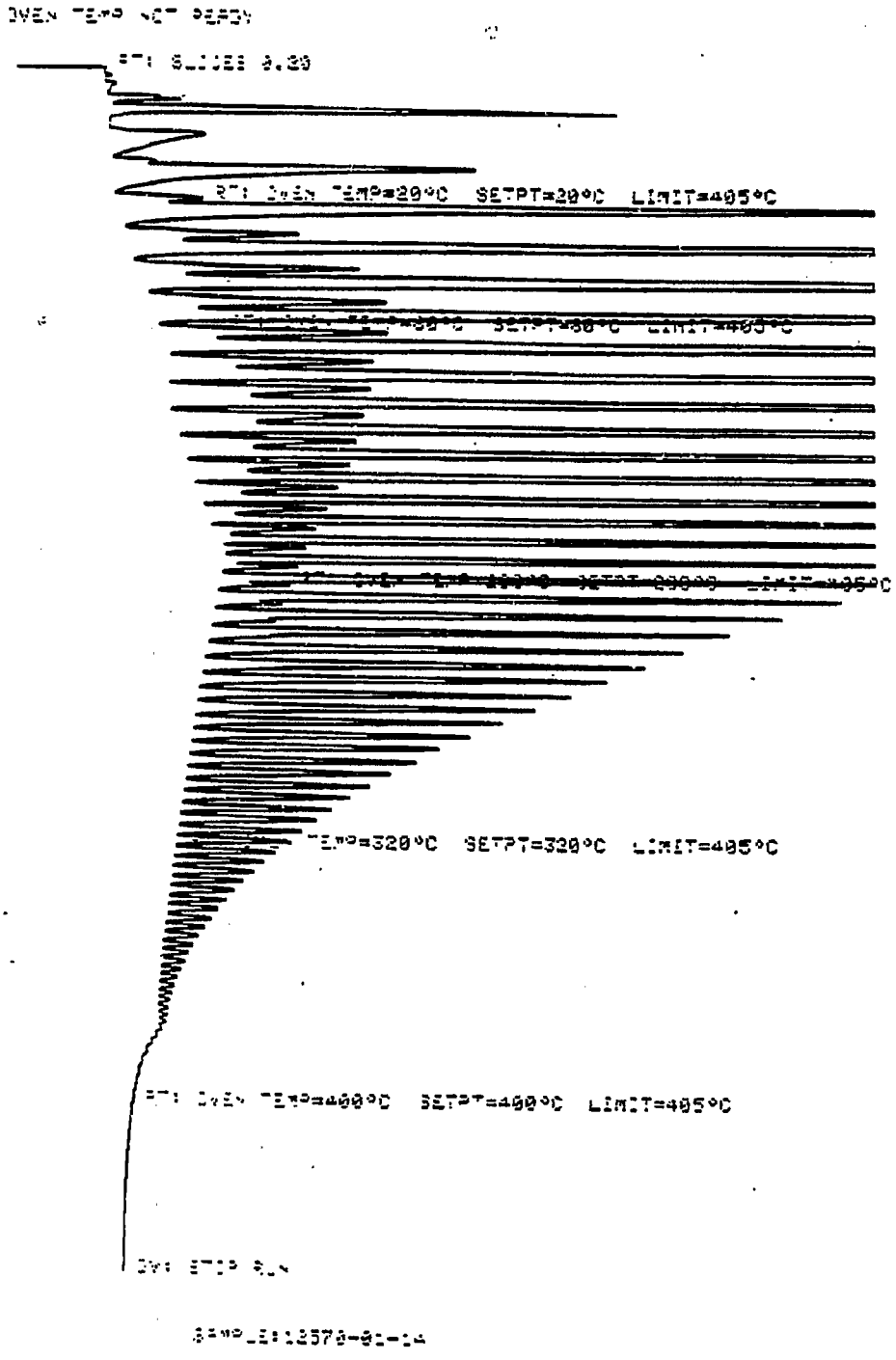
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Fig. B191

Table B20

FILE: 1257001A TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 12570-01
CATALYST CO/X11-U103 80 CC 32.0 G AFTER USE:48.7 G (+16.7 G)
FEED H2:CO OF 50:50 @400 CC/MN OR 300 GHSV (CAT#12524-7)

RUN & SAMPLE NO.	12570-01-01	570-01-02	570-01-03	570-01-04	570-01-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	21.0	45.0	68.0	93.5	117.5
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	242	242	243	243	243
FEED CC/MIN	400	400	400	400	400
HOURS FEEDING	21.00	24.00	23.00	25.50	24.00
EFFLNT GAS LITER	252.00	274.00	293.00	332.00	315.80
GM AQUEOUS LAYER	52.67	45.54	45.24	48.68	44.88
GM OIL	9.41	36.11	35.52	34.56	32.82
MATERIAL BALANCE					
GM ATOM CARBON %	75.96	86.36	94.58	92.58	94.33
GM ATOM HYDROGEN %	79.24	87.48	94.20	91.99	92.31
GM ATOM OXYGEN %	94.98	82.82	90.47	90.26	90.97
RATIO CHX/(H2O+CO2)	0.4214	1.1412	1.1574	1.0923	1.1360
RATIO X IN CHX	2.3451	2.2116	2.2172	2.2166	2.2188
USAGE H2/CO PRODT	2.7840	1.7948	1.7890	1.8628	1.8286
FEED H2/CO FRM EFFLNT	1.0432	1.0129	0.9960	0.9937	0.9786
RESIDUAL H2/CO RATIO	0.5546	0.5859	0.5863	0.5990	0.5888
RATIO CO2/(H2O+CO2)	0.0848	0.0765	0.0762	0.0614	0.0647
K SHIFT IN EFFLNT	0.0514	0.0485	0.0484	0.0392	0.0407
SPECIFIC ACTIVITY SA	2.1224	3.5364	3.2778	2.8371	2.8876
CONVERSION					
ON CO %	21.02	35.33	34.07	31.23	31.44
ON H2 %	58.49	62.59	61.19	58.55	58.75
ON CO+H2 %	40.59	49.05	47.60	44.85	44.95
PRDT SELECTIVITY,WT %					
CH4	12.14	4.74	5.01	5.08	5.13
C2 HC'S	1.93	1.00	1.13	1.03	1.43
C3H8	2.56	1.18	1.26	1.29	1.31
C3H6=	3.72	2.25	2.50	2.76	2.78
C4H10	2.62	1.25	1.36	1.40	1.40
C4H8=	4.59	2.62	2.91	3.11	3.13
C5H12	2.79	1.38	1.53	1.56	1.58
C5H10=	3.33	1.91	2.15	2.42	2.47
C6H14	3.81	1.87	2.08	2.26	2.25
C6H12= & CYCLO'S	1.97	1.10	1.34	1.63	1.61
C7+ IN GAS	14.97	5.86	6.11	7.07	7.64
LIQ HC'S	45.56	74.84	72.62	70.39	69.27
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	27.57	13.04	14.17	14.67	15.18
C5 -420 F	41.91	28.74	49.52	50.14	29.54
420-700 F	26.65	31.58	29.05	28.15	25.21
700-END PT	3.87	26.64	7.26	7.04	30.06

Table B20 (continued)

FILE: 1257001A TSS4Q1 A1

C5+-END PT	72.43	86.96	85.83	85.33	84.82
ISO/NORMAL MOLE RATIO					
C4	0.0235	0.0274	0.0223	0.0234	0.0196
C5	0.0680	0.0668	0.0739	0.0723	0.0647
C6	0.3230	0.2728	0.2769	0.2775	0.2732
C4=	0.0607	0.0555	0.0563	0.0584	0.0545
PARAFFIN/OLEFIN RATIO					
C3	0.6581	0.5021	0.4828	0.4463	0.4509
C4	0.5497	0.4600	0.4505	0.4349	0.4318
C5	0.8143	0.7013	0.6893	0.6263	0.6219
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8192	0.8927	0.7605	0.7749	0.8769
RATIO CH4/(1-A)**2	3.7137	4.1138	0.8736	1.0024	3.3856
ALPHA FRM CORRELATION	0.8405	0.8379			0.8376
ALPHA (EXPTL/CORR)	0.9746	1.0654			1.0470
W%CH4 FRM CORRELATION	13.3631	14.1919			14.5097
W%CH4 (EXPTL/CORR)	0.9086	0.3338			0.3534
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLD OIL	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	303	342			345
16	344	382			398
50	488	600			644
84	647	863			955
90	690	933			1033
RANGE(16-84 %)	303	481			557
WT % @ 420 F	33.00	22.20	50.00	50.00	20.20
WT % @ 700 F	91.50	64.40	90.00	90.00	56.60

Table B21

FILE: 1257001B TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 12570-01
CATALYST CO/K11-U103 80 CC 32.0 G AFTER USE:48.7 G (+16.7 G)
FEED H2:CO OF 50:50 @400 CC/MN OR 300 GHSV (CAT#12524-7)

RUN & SAMPLE NO.	12570-01-06	570-01-07	570-01-08	570-01-09	570-01-10
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	140.0	165.0	187.0	211.0	235.0
PRESSURE,PSIG	300	300	300	300	300
TEMP. C	243	243	243	243	262
FEED CC/MIN	400	400	400	400	400
HOURS FEEDING	22.50	25.00	22.00	24.00	24.00
EFFLNT GAS LITER	299.00	333.00	293.00	320.00	270.00
GM AQUEOUS LAYER	38.17	46.85	40.91	45.91	51.78
GM OIL	25.55	31.75	31.21	27.97	32.97
MATERIAL BALANCE					
GM ATOM CARBON %	90.18	92.31	94.77	91.10	92.96
GM ATOM HYDROGEN %	87.49	91.32	94.17	90.41	91.42
GM ATOM OXYGEN %	88.47	90.79	90.49	91.31	91.48
RATIO CHX/(H2O+CO2)	1.0764	1.0626	1.1759	0.9913	1.0466
RATIO X IN CHX	2.2238	2.2181	2.2198	2.2264	2.3388
USAGE H2/CO PRODT	1.8959	1.9185	1.8332	1.9749	1.6597
FEED H2/CO FRM EFFLNT	0.9702	0.9893	0.9937	0.9925	0.9834
RESIDUAL H2/CO RATIO	0.6093	0.6045	0.6077	0.6036	0.4906
RATIO CO2/(H2O+CO2)	0.0539	0.0479	0.0528	0.0490	0.1830
K SHIFT IN EFFLNT	0.0347	0.0304	0.0339	0.0311	0.1099
SPECIFIC ACTIVITY SA	2.4388	2.6022	2.8169	2.4462	1.9462
CONVERSION					
ON CO %	28.05	29.28	31.50	28.36	42.15
ON H2 %	54.82	56.79	58.11	56.43	71.14
ON CO+H2 %	41.23	42.96	44.76	42.34	56.52
PRDT SELECTIVITY,WT %					
CH4	5.54	5.14	5.11	5.88	10.92
C2 HC'S	1.35	1.26	1.49	1.60	2.18
C3H8	1.41	1.34	1.32	1.50	2.51
C3H6=	3.21	3.02	2.85	3.24	2.34
C4H10	1.51	1.46	1.41	0.15	2.27
C4H8=	3.57	3.38	3.12	3.63	3.42
C5H12	1.71	1.61	1.56	1.79	2.59
C5H10=	2.80	2.53	2.47	2.80	2.24
C6H14	2.38	2.02	2.17	2.49	3.91
C6H12= & CYCLO'S	1.75	1.23	1.55	1.86	1.57
C7+ IN GAS	7.79	7.22	6.37	7.79	8.00
LIQ HC'S	66.98	69.79	70.58	67.26	58.05
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	16.60	15.59	15.30	16.01	23.64
C5 -420 F	49.91	49.51	49.41	31.67	36.42
420-700 F	26.79	27.92	28.23	25.62	24.50
700-END PT	6.70	6.98	7.06	26.70	15.44

Table B21 (continued)

FILE: 1257001B TSS4Q1 A1

C5+-END PT	83.40	84.41	84.70	83.99	76.36
ISO/NORMAL MOLE RATIO					
C4	0.0000	0.0193	0.0227	0.0000	0.0176
C5	0.0786	0.0763	0.0665	0.0598	0.0949
C6	0.2729	0.2829	0.2818	0.2643	0.4808
C4=	0.0557	0.0564	0.0535	0.0543	0.0915
PARAFFIN/OLEFIN RATIO					
C3	0.4209	0.4240	0.4437	0.4427	1.0229
C4	0.4093	0.4165	0.4364	0.0400	0.6389
C5	0.5942	0.6167	0.6141	0.6236	1.1240
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.7587	0.7164	0.7586	0.8721	0.8557
RATIO CH4/(1-A)**2	0.9518	0.6385	0.8765	3.5950	5.2453
ALPHA FRM CORRELATION				0.8364	0.8454
ALPHA (EXPTL/CORR)				1.0428	1.0122
W%CH4 FRM CORRELATION				14.8856	16.1995
W%CH4 (EXPTL/CORR)				0.3950	0.6740
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F				342	300
16				382	341
50				620	540
84				940	801
90				1026	883
RANGE(16-84 %)				558	460
WT % @ 420 F	50.00	50.00	50.00	22.20	31.20
WT % @ 700 F	90.00	90.00	90.00	60.30	73.40

Table B22

FILE: 1257001C TSS4Q1 A1

RESULT OF SYNGAS OPERATION

RUN NO. 12570-01
CATALYST CO/X11-U103. 90 CC 32.0 G. AFTER USE:48.7 G (+16.7 G)
FEED H2:CO OF 50:50 @400 CC/MN OR 300 GHSV (CAT#12524-7)

RUN & SAMPLE NO.	12570-01-11	570-01-12	570-01-13	570-01-14
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	338.0	357.0	381.5	405.5
PRESSURE,PSIG	300	300	300	300
TEMP. C	262	261	261	261
FEED CC/MIN	400	400	400	400
HOURS FEEDING	103.00	19.00	24.50	24.00
EFFLNT GAS LITER	1163.90	217.00	286.50	280.80
GM AQUEOUS LAYER	219.68	43.27	54.54	54.10
GM OIL	144.66	22.94	34.25	31.12
MATERIAL BALANCE				
GM ATOM CARBON %	91.26	89.17	94.37	91.93
GM ATOM HYDROGEN %	89.29	89.52	94.49	91.73
GM ATOM OXYGEN %	89.90	91.17	91.50	92.14
RATIO CHX/(H2O+CO2)	1.0454	0.9358	1.0938	0.9929
RATIO X IN CHX	2.3199	2.3253	2.2957	2.3204
USAGE H2/CO PRODT	1.7536	1.8636	1.7596	1.8356
FEED H2/CO FRM EFFLNT	0.9784	1.0039	1.0013	0.9978
RESIDUAL H2/CO RATIO	0.4881	0.5014	0.5108	0.5033
RATIO CO2/(H2O+CO2)	0.1378	0.1202	0.1199	0.1162
K SHIFT IN EFFLNT	0.0780	0.0685	0.0696	0.0661
SPECIFIC ACTIVITY SA	1.7390	1.6646	1.7703	1.6528
CONVERSION				
ON CO %	38.74	36.89	39.28	37.12
ON H2 %	69.44	68.48	69.02	68.29
ON CO+H2 %	53.92	52.72	54.16	52.69
PRDT SELECTIVITY,WT %				
CH4	10.06	10.39	8.76	10.05
C2 HC'S	1.95	2.13	1.71	1.91
C3H8	2.16	2.29	2.32	2.21
C3H6=	2.49	2.78	2.75	2.68
C4H10	1.95	2.12	2.18	2.12
C4H8=	3.25	3.59	3.71	3.52
C5H12	2.01	2.42	2.52	2.44
C5H10=	2.11	2.44	2.55	2.49
C6H14	3.18	3.74	3.89	3.78
C6H12= & CYCLO'S	1.32	1.63	1.71	1.65
C7+ IN GAS	6.07	8.02	8.74	7.25
LIQ HC'S	63.45	58.43	59.17	59.90
TOTAL	100.00	100.00	100.00	100.00
SUB-GROUPING				
C1 -C4	21.86	23.31	21.42	22.48
C5 -420 F	32.89	47.48	48.99	36.36
420-700 F	26.33	23.37	23.67	24.20
700-END PT	18.91	5.84	5.92	16.95

Table B22 (continued)

FILE: 1257001C TSS4Q1 A1

C5+-END PT	78.14	76.69	78.58	77.52
ISO/NORMAL MOLE RATIO				
C4	0.0155	0.0192	0.0177	0.0217
C5	0.0000	0.0857	0.0804	0.0820
C6	0.4909	0.4511	0.4533	0.4555
C4=	0.0791	0.0802	0.0789	0.0812
PARAFFIN/OLEFIN RATIO				
C3	0.8288	0.7865	0.8045	0.7876
C4	0.5790	0.5689	0.5663	0.5807
C5	0.9267	0.9658	0.9641	0.9521
SCHULZ-FLORY DISTRBTN				
ALPHA (EXP(SLOPE))	0.8643	0.7952	0.8064	0.8530
RATIO CH4/(1-A)**2	5.4649	2.4771	2.3365	4.6554
ALPHA FRM CORRELATION	0.8456			0.8442
ALPHA (EXPTL/CORR)	1.0221			1.0105
W%CH4 FRM CORRELATION	16.1244			16.3597
W%CH4 (EXPTL/CORR)	0.6242			0.6145
LIQ HC COLLECTION				
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY				
N, REFRACTIVE INDEX				
SIMULT'D DISTILATN				
10 WT % @ DEG F	315			299
16	347			341
50	545			540
84	832			824
90	904			906
RANGE(16-84 %)	485			483
WT % @ 420 F	28.70	50.00	50.00	31.30
WT % @ 700 F	70.20	90.00	90.00	71.70

XI. Summary

The work reported during this Quarter was directed to exploring and refining the promising developments obtained in the Fourth Quarter, and focused primarily on the newly developed promoter, X_{11}, which was used in Catalyst 32.

In two of the ten runs, the performance of the new Molecular Sieves TC-114 and TC-115 was investigated. Neither produced any improvement over the performance of TC-103.

Other runs tested the effects of raising the concentrations of cobalt and X_{11} and varying the pretreatment of the catalyst. At higher cobalt levels the methane production was reduced but stability was impaired. Higher levels of X_{11} produced no apparent improvements at 240C, and had a deleterious effect at 260C. With different methods of pretreating the catalyst there were some improvements in performance, substantial enough to warrant further investigation.

A new promoter, X_{12}, tested in combination with X_{11}, improved the catalyst's activity, had no effect on selectivity, and showed excellent stability at 240C but poor stability at 260C.

Finally, an exact duplicate of the promising Catalyst 32 (Run 12200-19, Fourth Quarterly Report) was run in an attempt to replicate the earlier results. Aside from a slightly inferior performance at 260C, the replication was successful.

APPENDIX C. ANALYSIS OF FISCHER-TROPSCH HYDROCARBONS BY DUAL CAPILLARY GAS CHROMATOGRAPHY

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Tables

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Abstract

Analysis of sample 11677-11-13 by dual column gas chromatography, for classes of Fischer-Tropsch reaction products gave the following weight percents (DB-1 column): 48.3% n-alkanes, 11.5% branched aliphatics, 1.9% 1-alkenes, 4.2% mixed 2-alkenes, 9.7% mixed olefins and 12.5% unidentified compounds. 11.9 weight percent of the sample was unaccounted for. Aromatic compounds, naphthalenes, and alcohols were not detected in the sample.

Introduction

A dual capillary gas chromatographic method for the characterization of Fischer-Tropsch reaction products, developed by the Pittsburgh Energy Technology Center (PETC)[1] has been successfully mobilized by the Union Carbide Corporation, (UCC) Tarrytown, N.Y., Central Scientific Laboratories.

This report will present the quantitative results obtained, by the dual column method, for a Fischer-Tropsch sample (11677-11-13) provided by the Molecular Sieve Department at Union Carbide Corporation, Tarrytown, N.Y.

Experimental

Instrument	Perkin-Elmer 900 gas chromatograph
Columns	J+W DB-1 and DB-5 60m x 0.32 mm ID
Carrier	H_2 @ 12 PSI μ = 22 cm sec^{-1} @ 100°C
Injection	Split 200:1 3.0µl injection volume
Temperature Program	0°C hold for 3 minutes then 2° min^{-1} to 340°C
Data Acquisition	Hewlett-Packard 3354 Laboratory Automation System

Results

Peak areas obtained for the n-alkanes present in both the neat sample and standard addition sample are tabulated in Table 1a and 1b for the DB-1 and DB-5 columns respectfully. The data presented shows very good agreement between the amount of sample each individual column receives from run to run (mean n-alkane ratio ca 6.2% difference).

Four standard additions were used to generate the peak area to weight percent correction factors, and these are tabulated in Table 2a, 2b & 2c. One should note the presence of 2-methyl heptane in the neat sample which is subsequently subtracted from the standard addition area of that component in the calculation of the correction factor. The other standards employed were not present in the neat sample. In selecting the standard additions, a range of structural features and a fairly even RI distribution were sought in order to "average" the correction factors even though a wide carbon number distribution and compound type was present in the sample.

As cis and trans 2-alkenes were of major interest, the PETC method provided for a individual analysis of this class of compound. The data obtained for the cis and trans 2-alkenes are tabulated in Table 3. Additionally, a graphical distribution of the 2-alkenes, found in this analysis, is presented.

The overall distribution of the various classes of compounds is tabulated in Tables 4a and 4b. Slight differences are to be expected due to the different resolving capacity of DB-1 and DB-5 columns. A graphical distribution of classes identified in sample 11677-11-13 is shown in Figure 1.

Conclusion

The PETC method for analysis of Fischer-Tropsch reaction products has been used for the analysis of sample 11677-11-13. Good agreement was obtained with the independent analysis of sample 11677-11-13 by the PETC group.

Future modifications and additions to the method, planned by UCC Molecular Sieves and Gas Chromatography departments, will tailor the method to our specific needs.

Work Done By: I. R. Ladd, T. M. Schear

Approved By: K. S. Buxton

Literature Cited

1. Hackett, J.P., Gibbon, G.A., Feldman, J.A., J. Chrom. Sci., 23:285 (1985)

NORMAL PARAFFIN AREA RATIO FOR FROST HEAT 3 AND FROST ADD 3 SE-30

CN	SAMPLE AREA	S.A. AREA	SAMPLE/S.A. RATIO
5	148519.	189866.	.782229
6	466261.	398638.	1.19384
7	1.48119E+06	1.35299E+06	1.09472
8	1.97292E+06	1.81698E+06	1.08582
9	3.53391E+06	3.27577E+06	1.0788
10	3.88889E+06	3.59389E+06	1.07964
11	3.86859E+06	3.56657E+06	1.08244
12	3.79857E+06	3.44821E+06	1.08789
13	3.48467E+06	3.16888E+06	1.07746
14	3.18624E+06	2.98894E+06	1.06887
15	2.87613E+06	2.74747E+06	1.04683
16	2.52543E+06	2.41122E+06	1.04737
17	2.17923E+06	2.11684E+06	1.02986
18	1.86888E+06	1.81584E+06	1.02481
19	1.59233E+06	1.56739E+06	1.01591
20	1.34126E+06	1.31955E+06	1.01645
21	1.10473E+06	1.09363E+06	1.01015
22	947868.	947468.	.999585
23	811488.	781247.	1.0387
24	646889.	615814.	1.0504
25	487467.	455784.	1.07423
26	342747.	314248.	1.09069
27	213434.	192817.	1.10693
28	188888.	178888.	1.05682
29	188888.	188888.	1
AVERAGE RATIO			1.04969
TOTAL AREA	7.38796E+07	8.32115E+07	.913878

Table 1a

NORMAL PARAFFIN AREA RATIO FOR FROST HEAT 3 AND FROST ADD 3 OV-17

CN	SAMPLE AREA	S.A. AREA	SAMPLE/S.A. RATIO
5	169344.	215491.	.785851
6	447226.	395623.	1.13043
7	1.29201E+06	1.16928E+06	1.10591
8	3.47887E+06	3.16143E+06	1.10016
9	4.38258E+06	3.99263E+06	1.09765
10	4.13415E+06	3.72383E+06	1.11019
11	4.85152E+06	3.65167E+06	1.1895
12	3.75442E+06	3.38738E+06	1.10836
13	3.48898E+06	3.16413E+06	1.10264
14	3.29458E+06	3.03117E+06	1.08687
15	3.03158E+06	2.81645E+06	1.07635
16	2.68463E+06	2.31424E+06	1.03595
17	2.38387E+06	2.19208E+06	1.05102
18	1.95856E+06	1.86973E+06	1.04748
19	1.66581E+06	1.63831E+06	1.00484
20	1.42589E+06	1.39378E+06	1.02177
21	1.20577E+06	1.18396E+06	1.01842
22	1.00428E+06	978790.	1.02684
23	829353.	808872.	1.03556
24	669388.	638183.	1.04888
25	507821.	479194.	1.05974
26	377884.	352748.	1.07128
27	281952.	268225.	1.08349
28	199528.	188281.	1.10676
29	125615.	110675.	1.13499
AVERAGE RATIO			1.06237
TOTAL AREA	7.88718E+07	8.48387E+07	.929567

Table 1b

Table 1a Normal alkane peak area ratios (DB-1 column). Neat sample and addition.

Table 1b Normal alkane peak area ratios (DB-5 column). Neat sample and addition.

Addition	RI(SE-30)	RI(OV-17)	WT%
2-methyl heptane	763	762	8.57
1,3-dimethyl-1-cyclohexene	813	820	3.05
cyclododecane	1305	1316	2.07
2,6,10,14-tetramethyl-pentadecane	1712	1708	3.13

Table 2a Standard additions added to Fischer-Tropsch sample for dual column GC analysis.

SE-30

ADDITION RI	AREA	HEAT RI	AREA	CF
763	3.99444E+06	763	276316.	9.67274E-07
		764	137322.	9.28969E-07
813	2.69286E+06	NONE	NONE	1.13151E-06
1305	2.29858E+06	NONE	NONE	9.83263E-07
1712	3.31956E+06	1711	43118.5	9.97118E-07

Table 2b Correction factors for standard additions (DB-1 column).

OV-17

ADDITION RI	AREA	HEAT RI	AREA	CF
762	4.80620E+06	762	163857.	9.32389E-07
		763	111855.	9.18968E-07
		764	149841.	9.28733E-07
820	2.83398E+06	821	49438.4	1.89572E-06
1316	2.42728E+06	NONE	NONE	8.52394E-07
1709	3.41685E+06	NONE	NONE	9.16949E-07

Table 2c Correction factors for standard additions (DB-5 column).

MAXIMUM WT% OF 2-OLEFINS
DETECTED BY DUAL COLUMN CAPILLARY GC

2-OLEFIN	CIS WT%	TRANS WT%
C-5,2-ENE	ND	.86
C-6,2-ENE	.11	.29
C-7,2-ENE	.1	.41
C-8,2-ENE	.25	.52
C-9,2-ENE	.23	.55
C-10,2-ENE	.19	.4
C-11,2-ENE	.14	.28
C-12,2-ENE	.09	.18
C-13,2-ENE	ND	.11
C-14,2-ENE	.08	.08
C-15,2-ENE	.07	.06
C-16,2-ENE	ND	ND
C-17,2-ENE	ND	ND
C-18,2-ENE	ND	ND
C-19,2-ENE	ND	ND
C-20,2-ENE	ND	ND
C-21,2-ENE	ND	ND
C-22,2-ENE	ND	ND
C-23,2-ENE	ND	ND
C-24,2-ENE	ND	ND
C-25,2-ENE	ND	ND
C-26,2-ENE	ND	ND
C-27,2-ENE	ND	ND
C-28,2-ENE	ND	ND
C-29,2-ENE	ND	ND
TOTAL	1.26	2.98

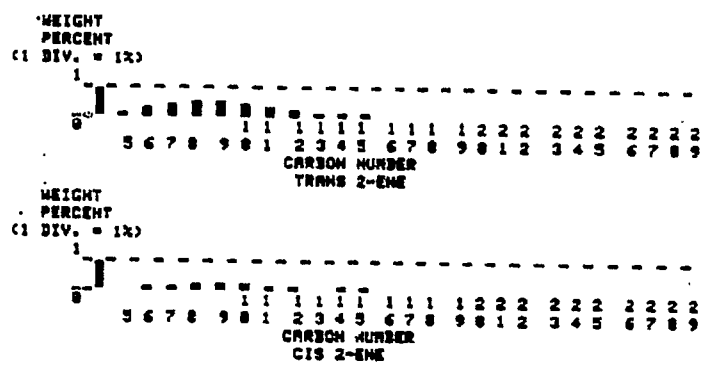

Table 3

Weight percents of cis and trans 2-alkenes detected in sample 11677-11-13 by dual column gas chromatography.

WT% OF ALIPHATIC HYDROCARBONS
DETECTED BY DUAL COLUMN CAPILLARY GC

CARBON NUMBER	TOTAL IN WINDOW	NORMAL PARAFFIN	1-ENE	2-ENE	BRANCHED ALIPHATIC	OLEFINIC STRUCTURE	UNIDENT-IFIED
5	.3	.24	---	.06	---	---	---
6	1.07	.48	.05	.39	---	.13	---
7	3.2	1.68	.1	.51	.32	.6	---
8	6.13	2.25	.11	.76	.79	1.37	.85
9	9.1	3.51	.06	.78	1.6	2.35	.8
10	10.01	4.05	.11	.59	1.88	1.99	1.39
11	9.68	4.13	.07	.42	1.76	1.29	1.1
12	8.09	4.09	.23	.27	.97	.84	1.69
13	7.25	3.8	.17	.11	.04	.6	1.72
14	5.89	3.61	.1	.16	.66	.25	1.12
15	5.22	3.34	.05	.13	.57	.16	.97
16	4.16	2.94	---	---	.47	---	.71
17	3.64	2.62	---	---	.41	---	.61
18	3.24	2.25	---	---	.34	.11	.55
19	2.69	1.94	---	---	.26	---	.49
20	2.24	1.63	---	---	.2	---	.4
21	1.89	1.35	---	---	.18	---	.35
22	1.47	1.17	---	---	.14	---	.15
23	1.23	.97	---	---	.11	---	.16
24	.76	.76	---	---	---	---	---
25	.56	.56	---	---	---	---	---
26	.39	.39	.56	---	---	---	---
27	.24	.24	---	---	---	---	---
28	.21	.21	---	---	---	---	---
29	.12	.12	---	---	---	---	---
30	---	---	---	---	---	---	---
>30	---	---	---	---	---	---	---
TOTAL	88.18	48.34	1.91	4.24	11.51	9.68	12.5

Table 4a Overall component distribution in 11677-11-13 (DB-1 column).

(OV-17)

WT% OF ALIPHATIC HYDROCARBONS
DETECTED BY DUAL COLUMN CAPILLARY GC

CARBON NUMBER	TOTAL IN WINDOW	NORMAL PARAFFIN	1-ENE	2-ENE	BRANCHED ALIPHATIC	OLEFINIC STRUCTURE	UNIDENT-IFIED
5	.32	.26	---	.06	---	---	---
6	1.03	.48	---	.39	---	.11	---
7	3.15	1.42	.09	.51	.31	.81	---
8	5.93	3.85	.15	.76	.63	.46	.08
9	9.13	4.87	.13	.78	1.66	1.12	.57
10	9.99	4.54	.89	.59	2.19	1.77	.81
11	9.26	4.45	.37	.42	1.75	.93	1.33
12	7.75	4.13	.21	.27	1.5	.41	1.23
13	6.4	3.86	.15	.11	1.12	.18	.98
14	5.95	3.7	.12	.16	.65	.18	1.14
15	5.33	3.43	.07	.13	.57	.88	1.05
16	4.26	3.07	---	---	.42	---	.73
17	3.69	2.67	---	---	.37	.05	.59
18	3.23	2.28	---	---	.32	.07	.57
19	2.83	2.02	---	---	.26	---	.55
20	2.37	1.7	---	---	.22	---	.45
21	2.81	1.44	---	---	.18	---	.39
22	1.53	1.19	---	---	.14	---	.19
23	1.22	.98	---	---	.11	---	.13
24	.91	.78	---	---	---	---	.88
25	.66	.58	---	---	---	---	.88
26	.5	.43	---	---	---	---	.07
27	.37	.32	---	---	---	---	.05
28	.22	.22	---	---	---	---	---
29	.13	.13	---	---	---	---	---
30	---	---	---	---	---	---	---
>30	---	---	---	---	---	---	---
TOTAL	88.18	52.82	1.38	4.24	12.45	6.17	11.12

Table 4b Overall component distribution in 11677-11-13 (DB-5 column).

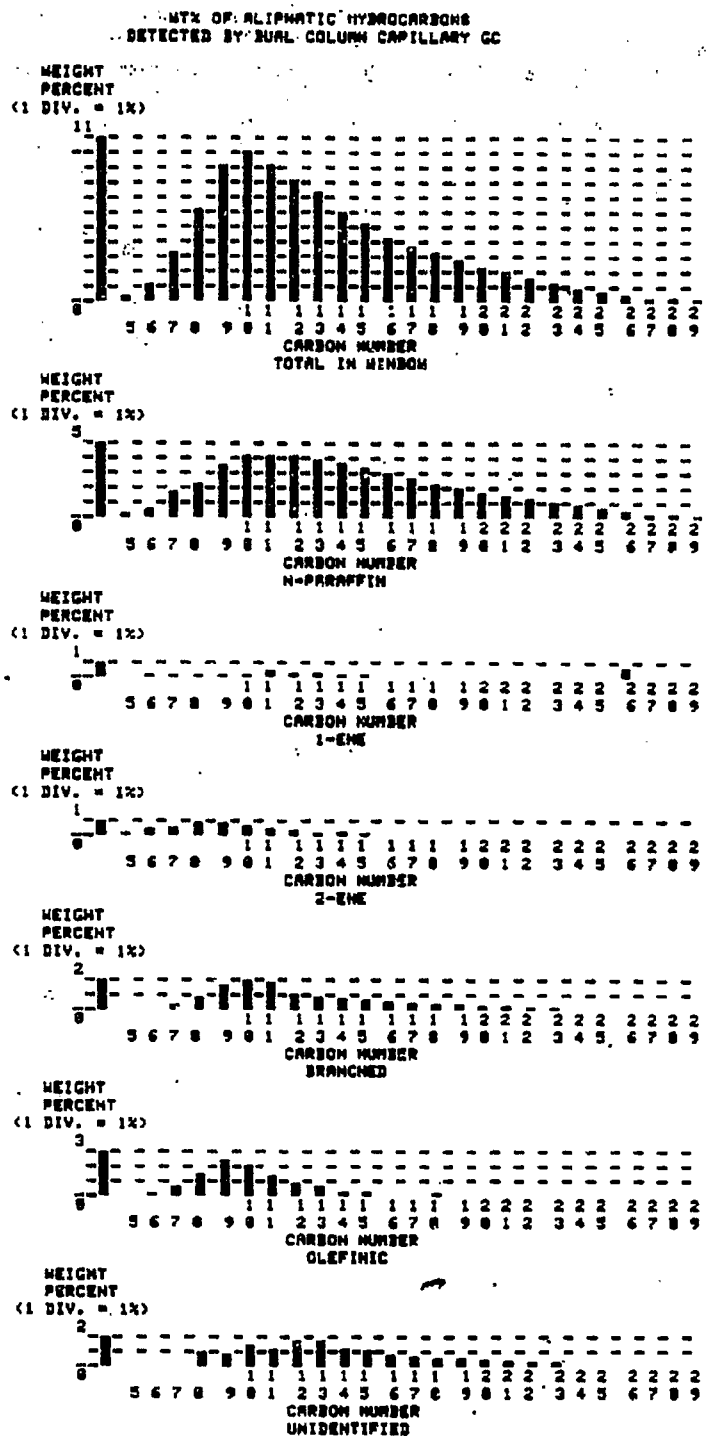

Figure 1: **Graphical distribution by carbon number of classes of components found in sample 11677-11-13 (DB-1 column).**

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