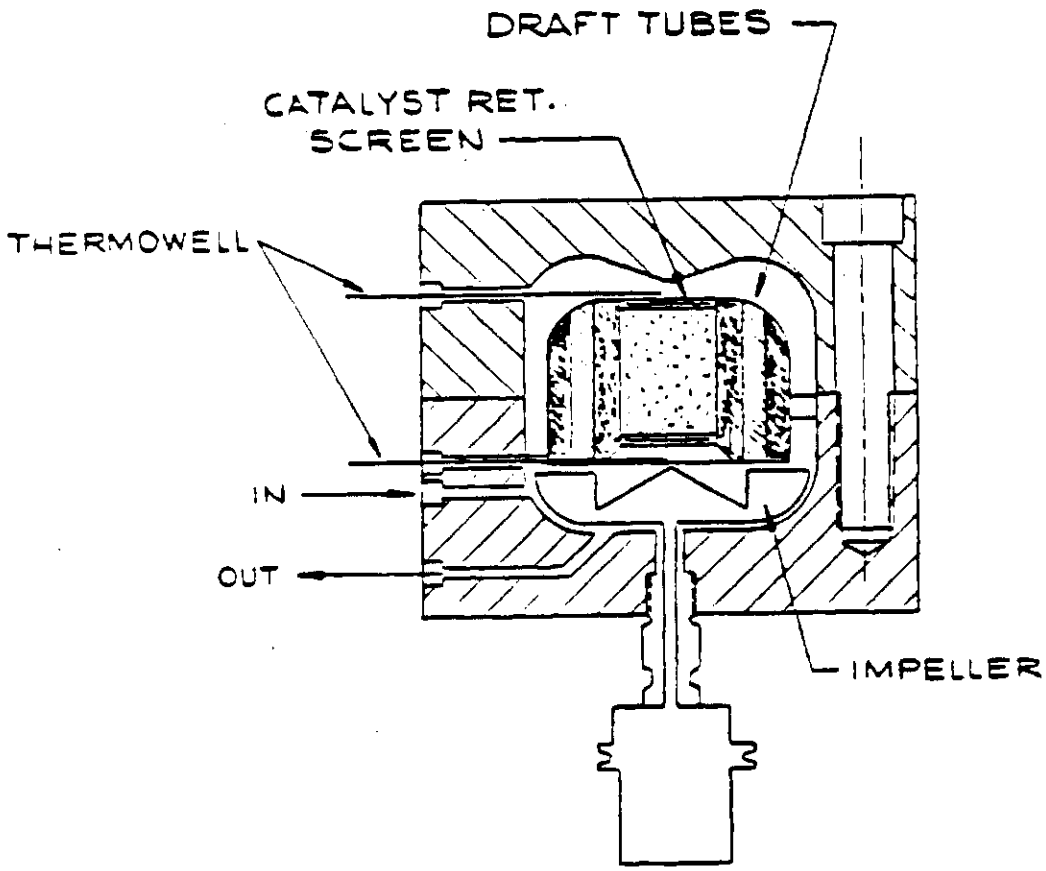


Fig. 1 Details of Berty Reactor

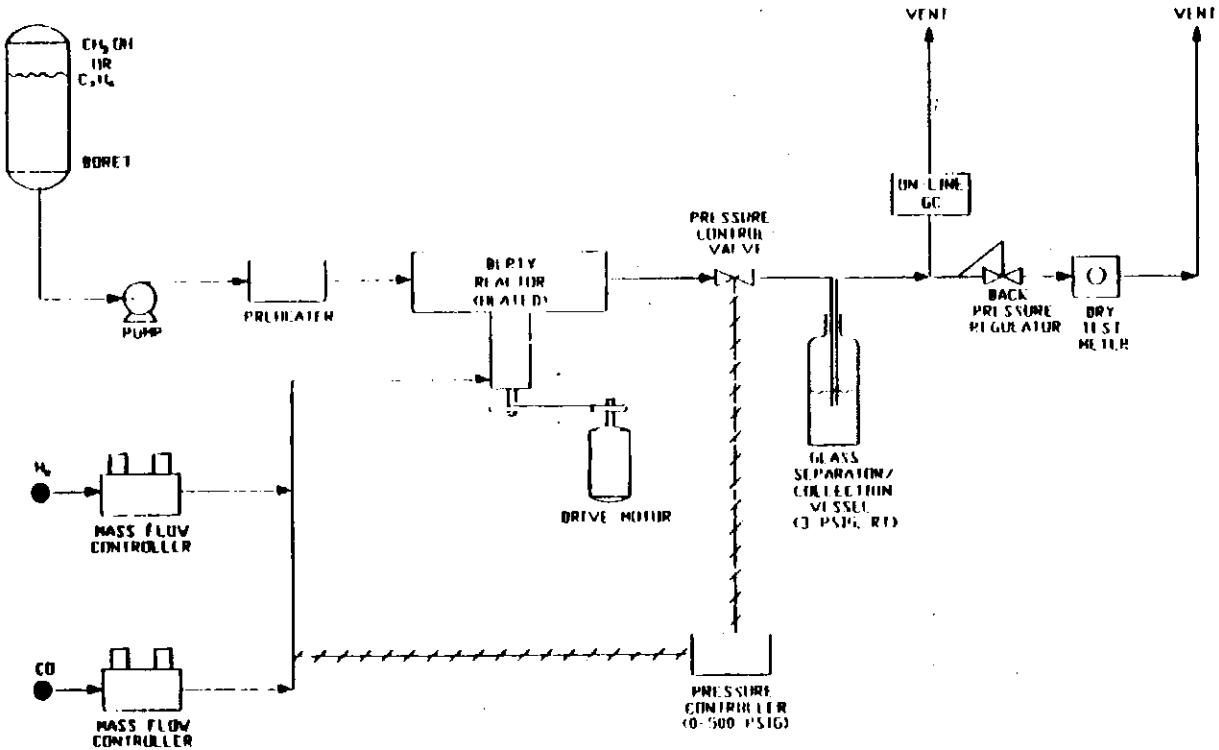
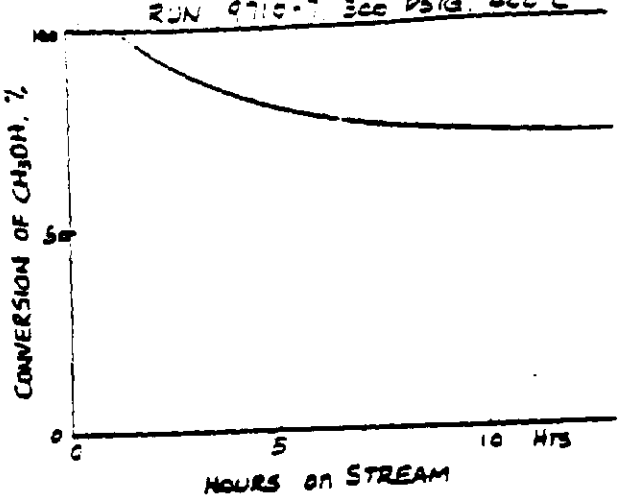
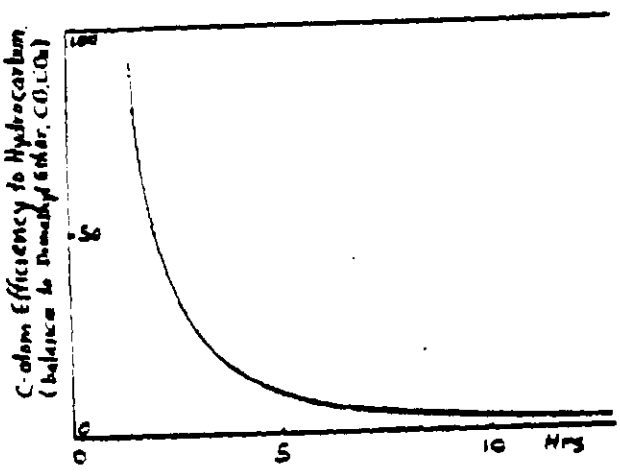


FIGURE 2
SCHEMATIC OF THE CATALYST TEST SYSTEM

Fig. 3
STABILITY OF Y-82 with CH_3CH
RUN 9710-7 300 PSIG. 400°C





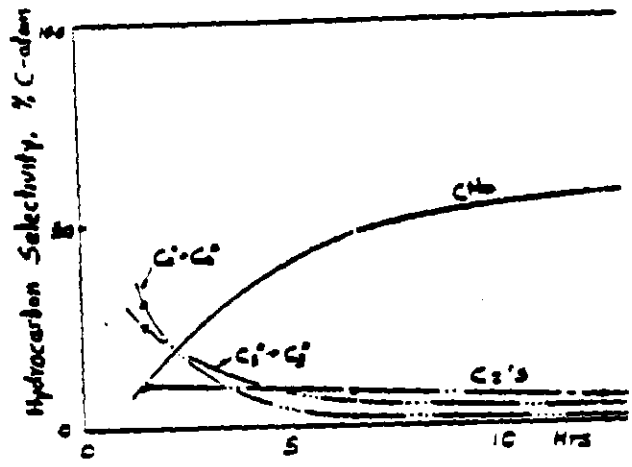
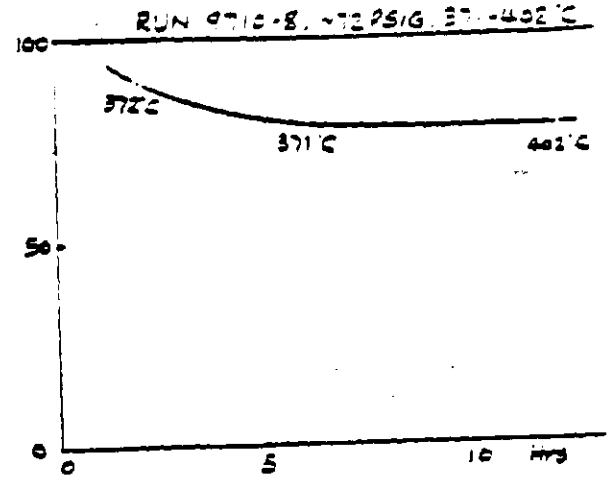
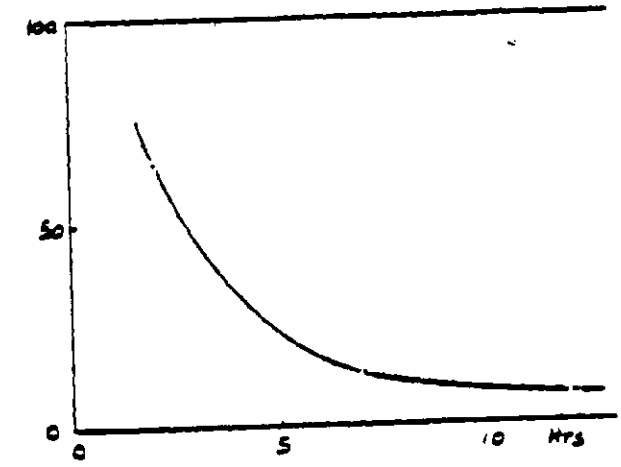


Fig. 4
STABILITY OF UCC-101
RUN 9710-8, ~72 PSIG, 37[illegible]-402°C





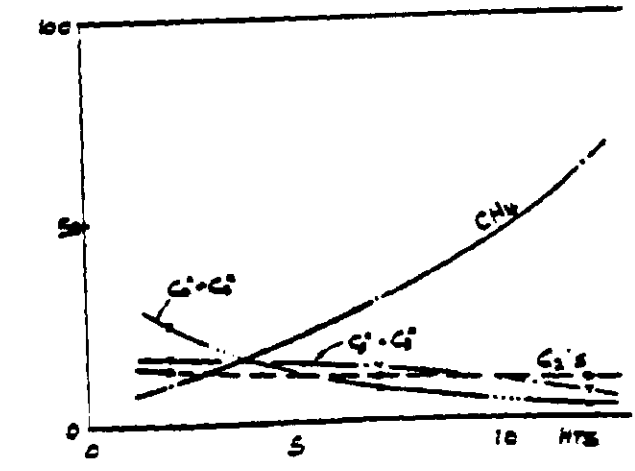
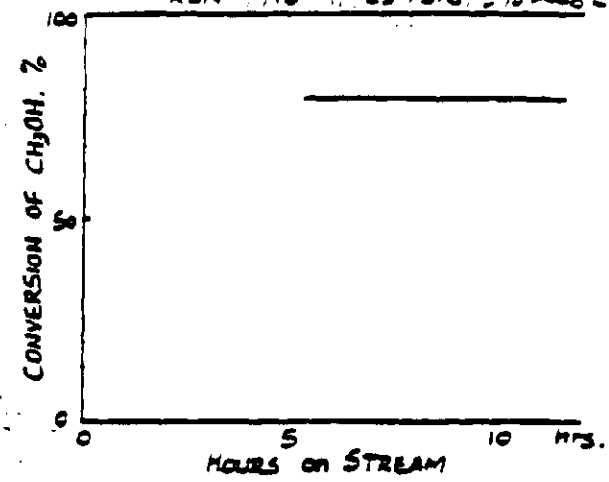
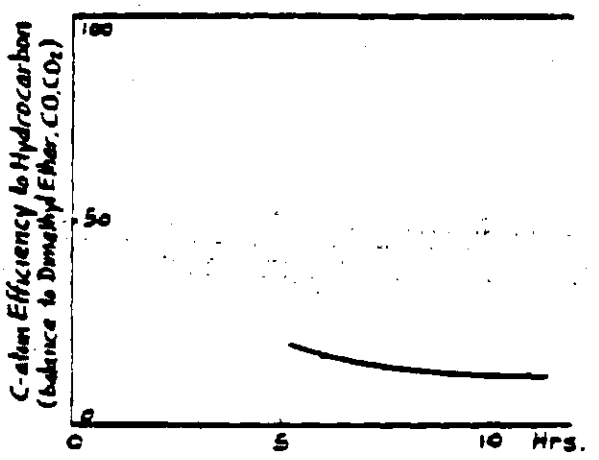


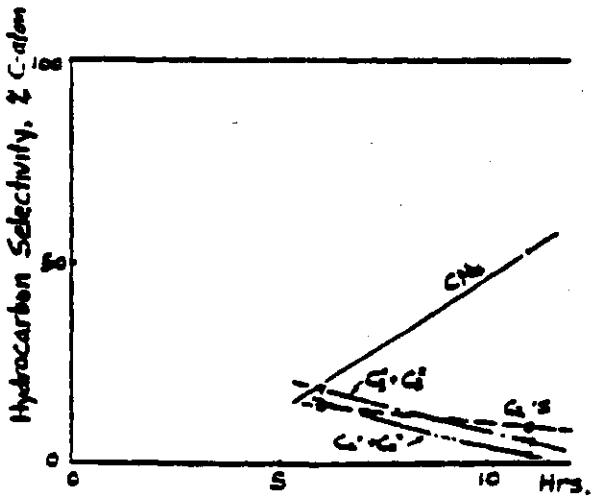
Fig. 5

STABILITY OF UCC-101

RUN 9710-9, 25 PSIG, 378 deg C







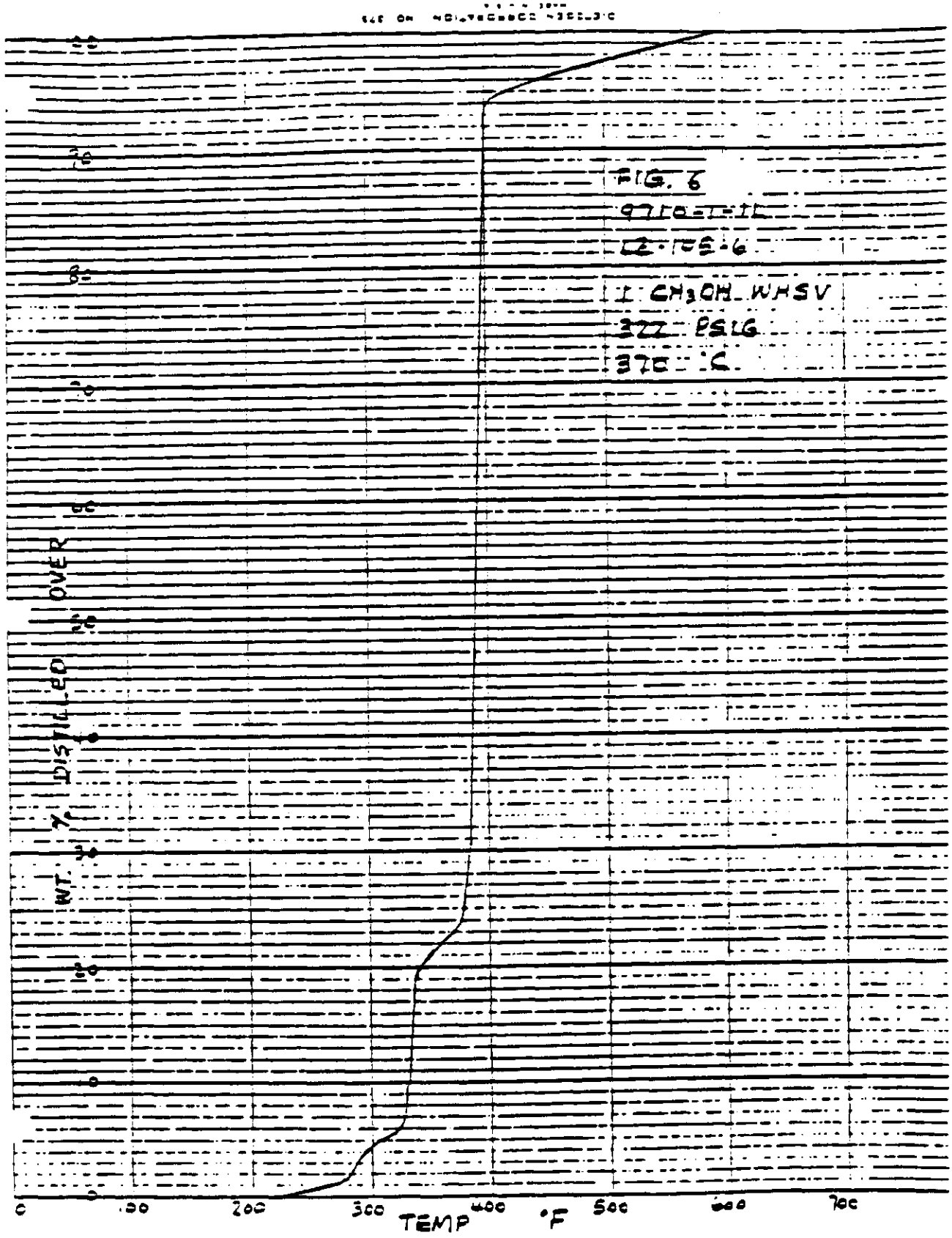


FIG. 6
9710-1-1L
CZ-105-6
1 CH3OH WHSV
322 PSIG
370 °C
% DISTILLED OVER
WT.
TEMP °F
0
100
200
300
400
500
600
700

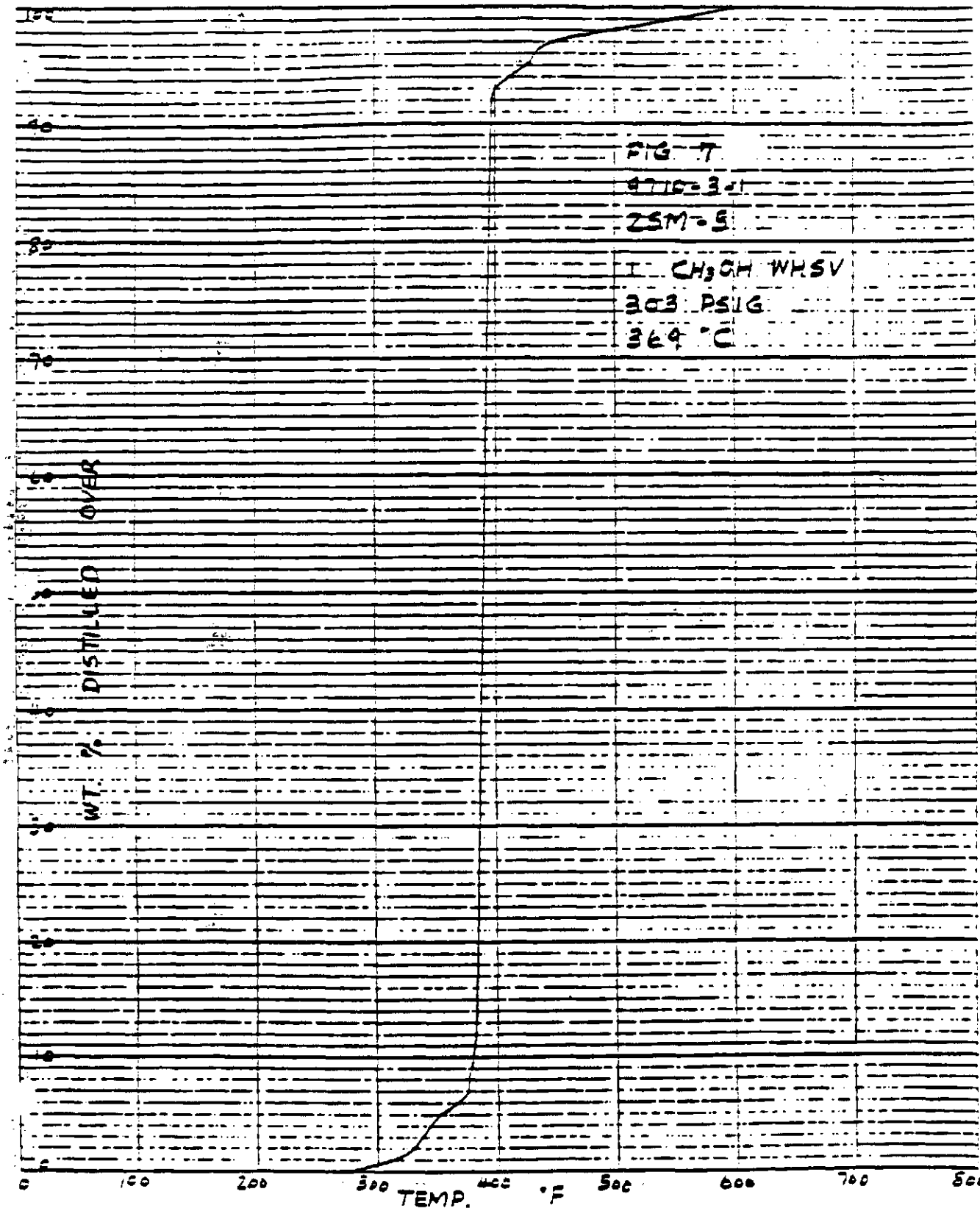


FIG 7
ZSM-5
CH3OH WHSV
303 PSIG
369 °C
WT. % DISTILLED OVER
0
100
200
300
400
500
600
700
800
TEMP. °F

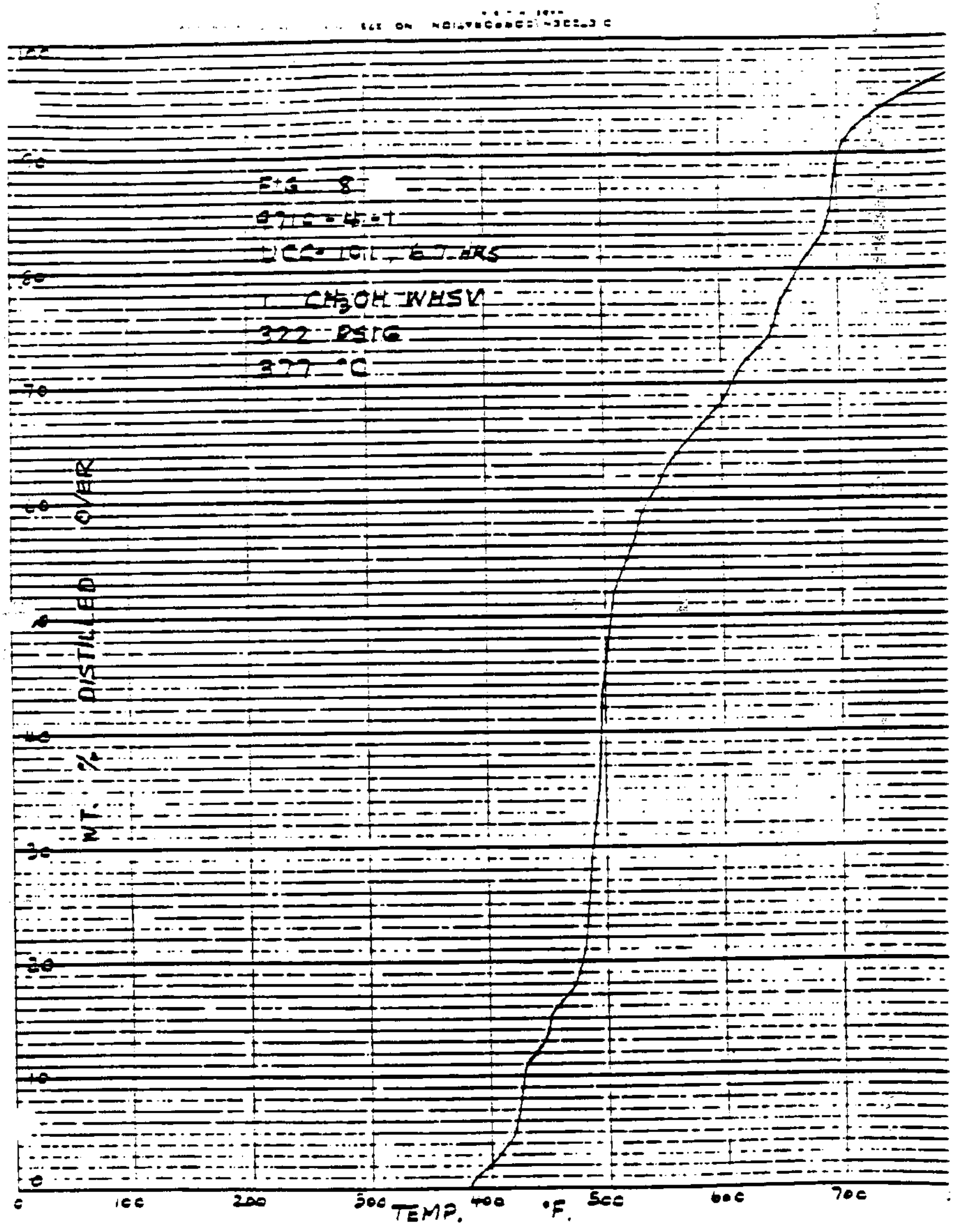


FIG 8
CH3OH WHSV
PSIG
°C
WT. % DISTILLED OVER
TEMP. °F.
0
100
200
300
400
500
600
700

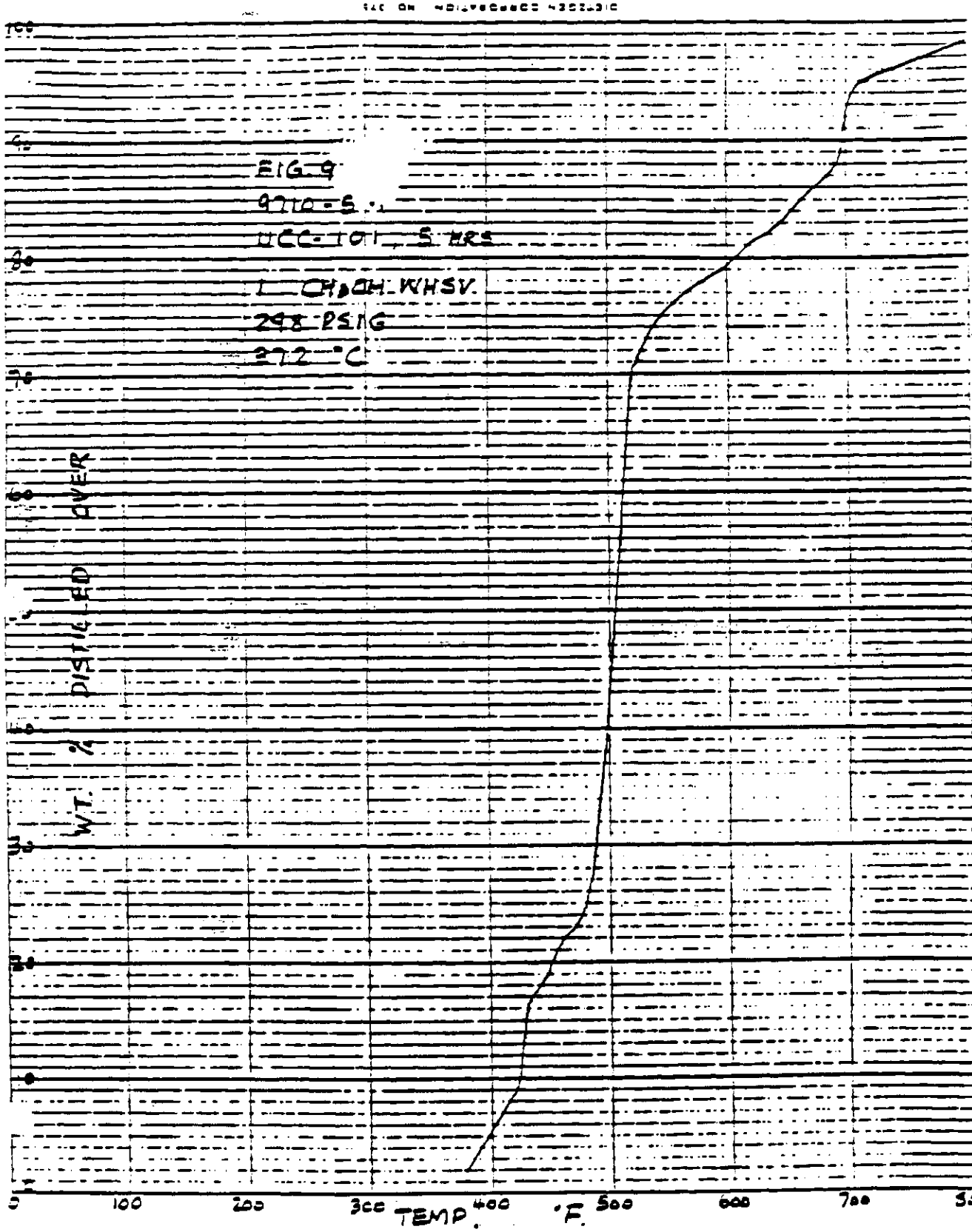


FIG 9
9710-5
UCC-101 5 HRS
1 CH3OH WHSV.
298 PSIG
272 °C
% DISTILLED OVER
WT.
100
80
70
60
50
40
30
20
10
0
100
200
300
400
500
600
700
800
TEMP. °F.

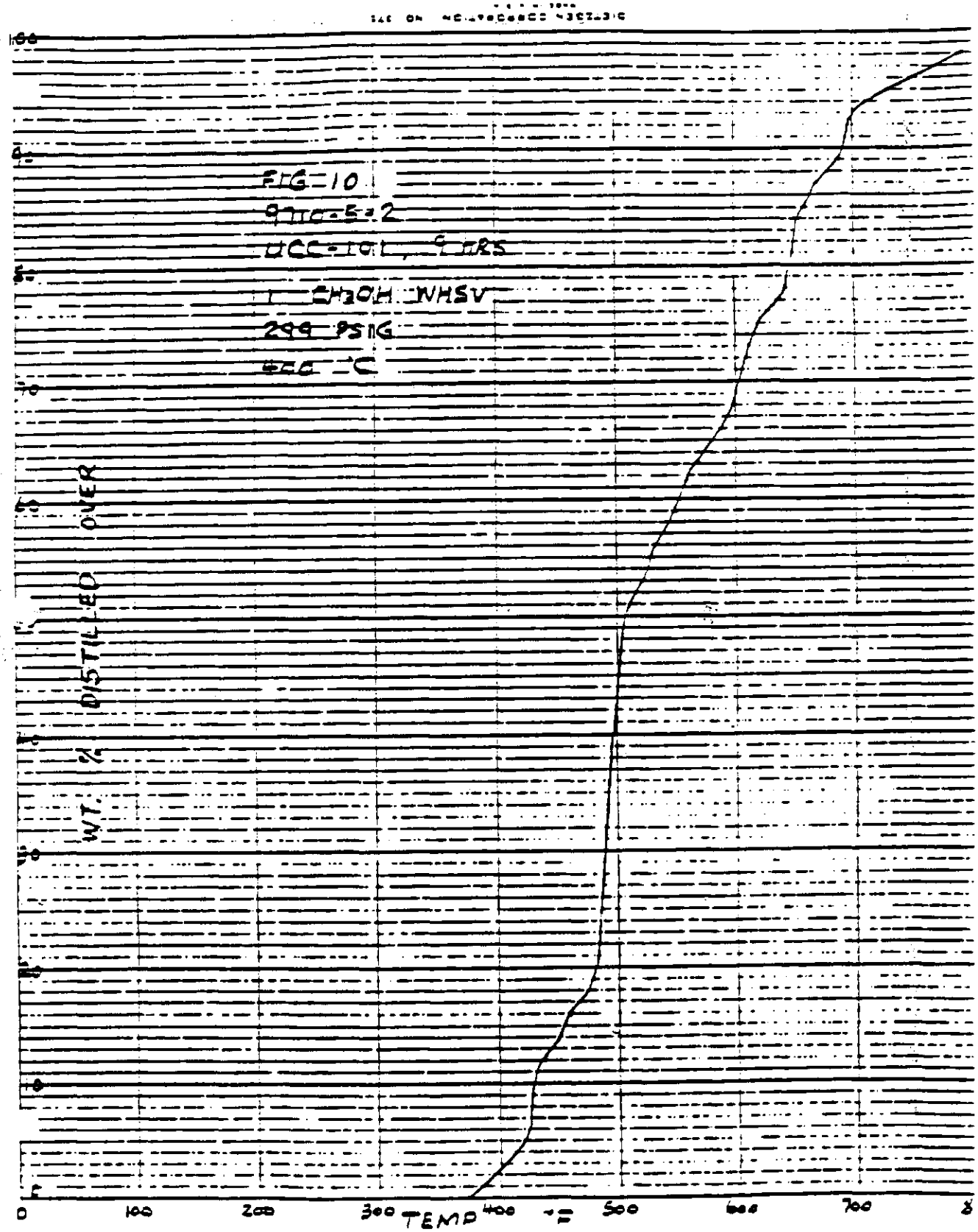


FIG-10
9TC-5-2
UCC-101, 9 HRS
1 CH3OH WHSV
299 PSIG
400 °C
WT. % DISTILLED OVER
0
100
200
300
TEMP
400
500
600
700
800

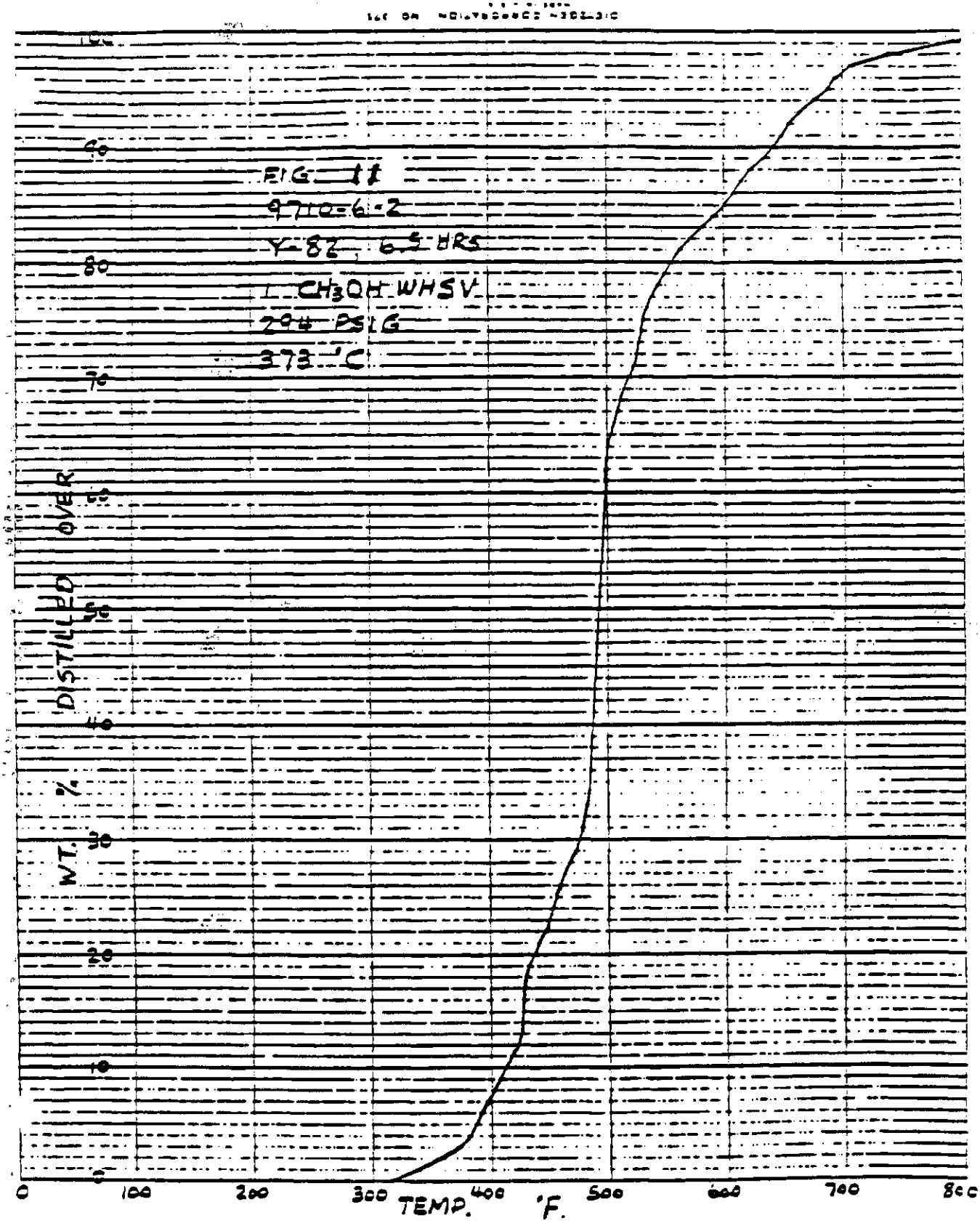


FIG 11
9710-6-2
Y-82, 6.5 HRS
CH3OH WHSV
200 PSIG
373 °C
DISTILLED OVER
WT. %
0
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
TEMP. °F.

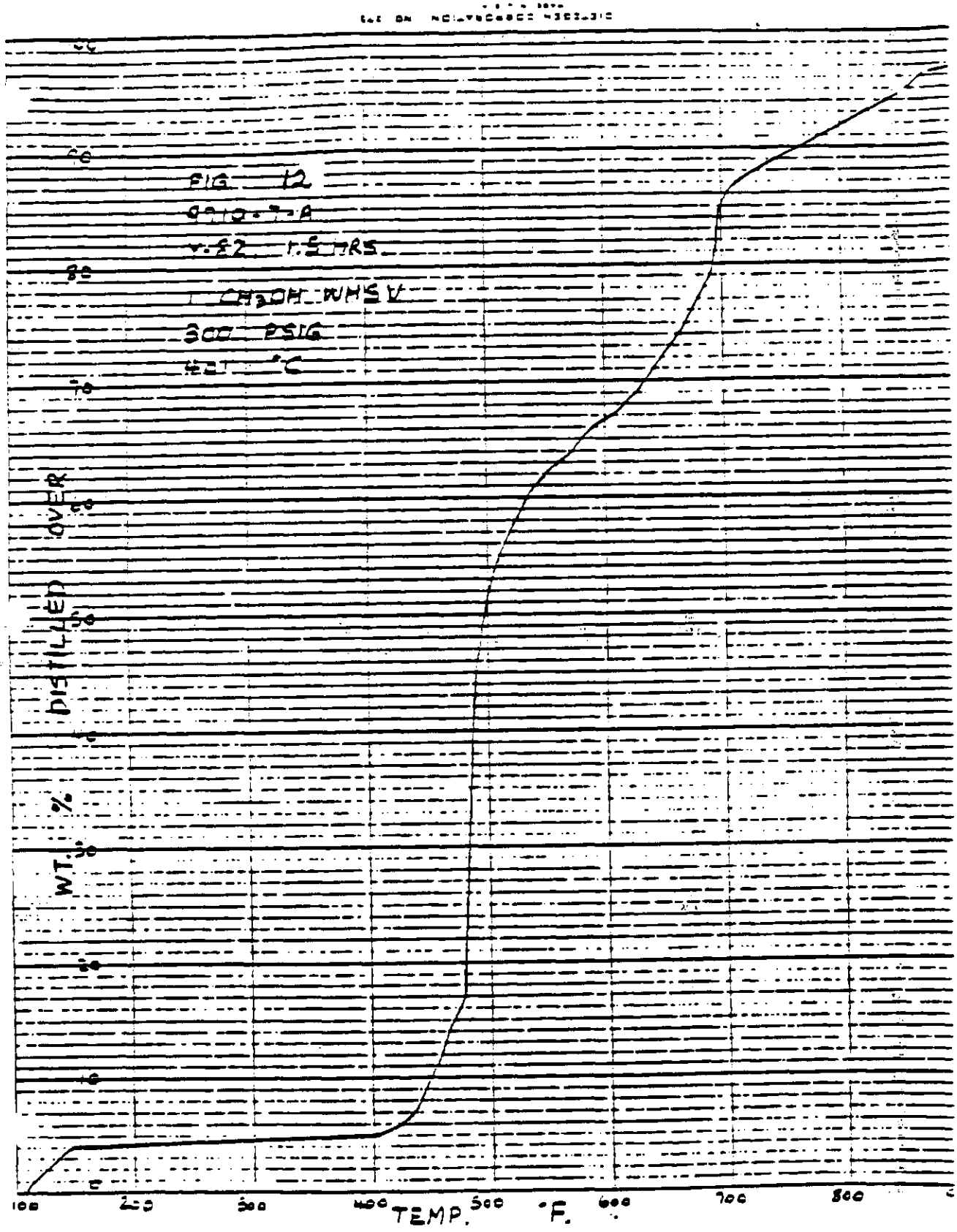


FIG 12
CH3OH WHSV
300 PSIG
°C
WT. % DISTILLED OVER
TEMP. °F.
100
200
300
400
500
600
700
800

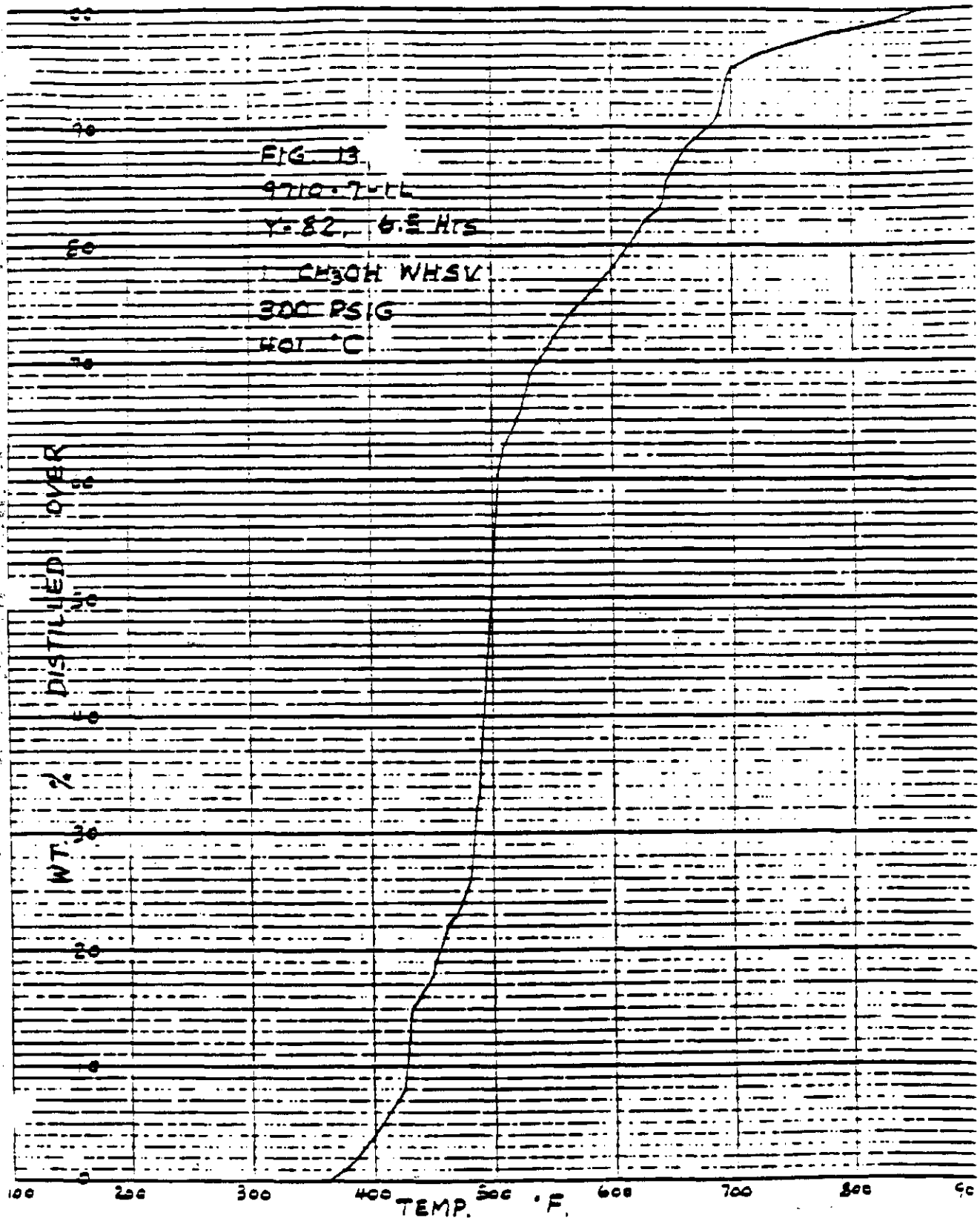


FIG 13
9710-71-L
Y-82, 6.5 HRS
CH3OH WHSV
300 PSIG
HOT °C
DISTILLED OVER
WT. %
TEMP. °F.
100
200
300
400
500
600
700
800

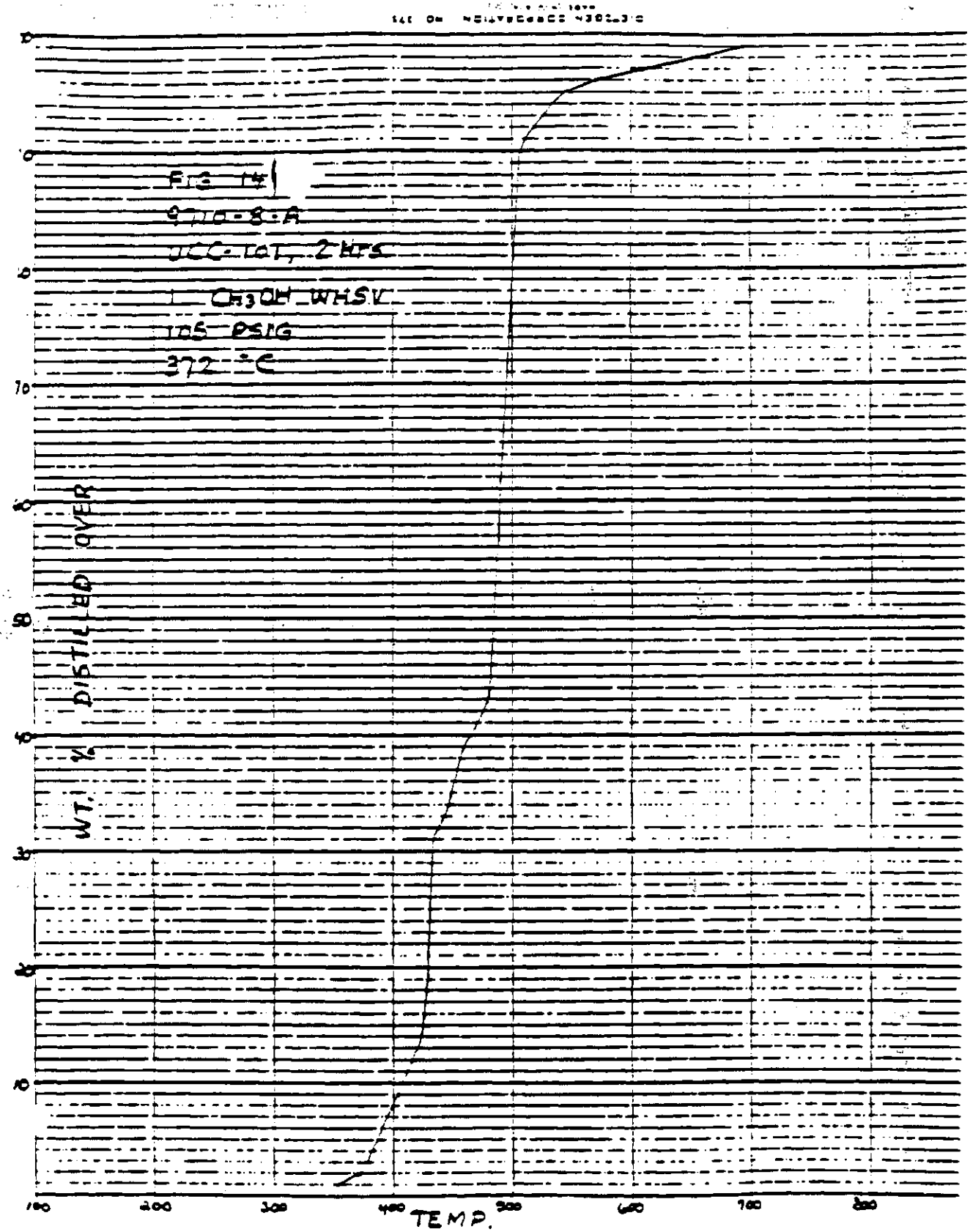
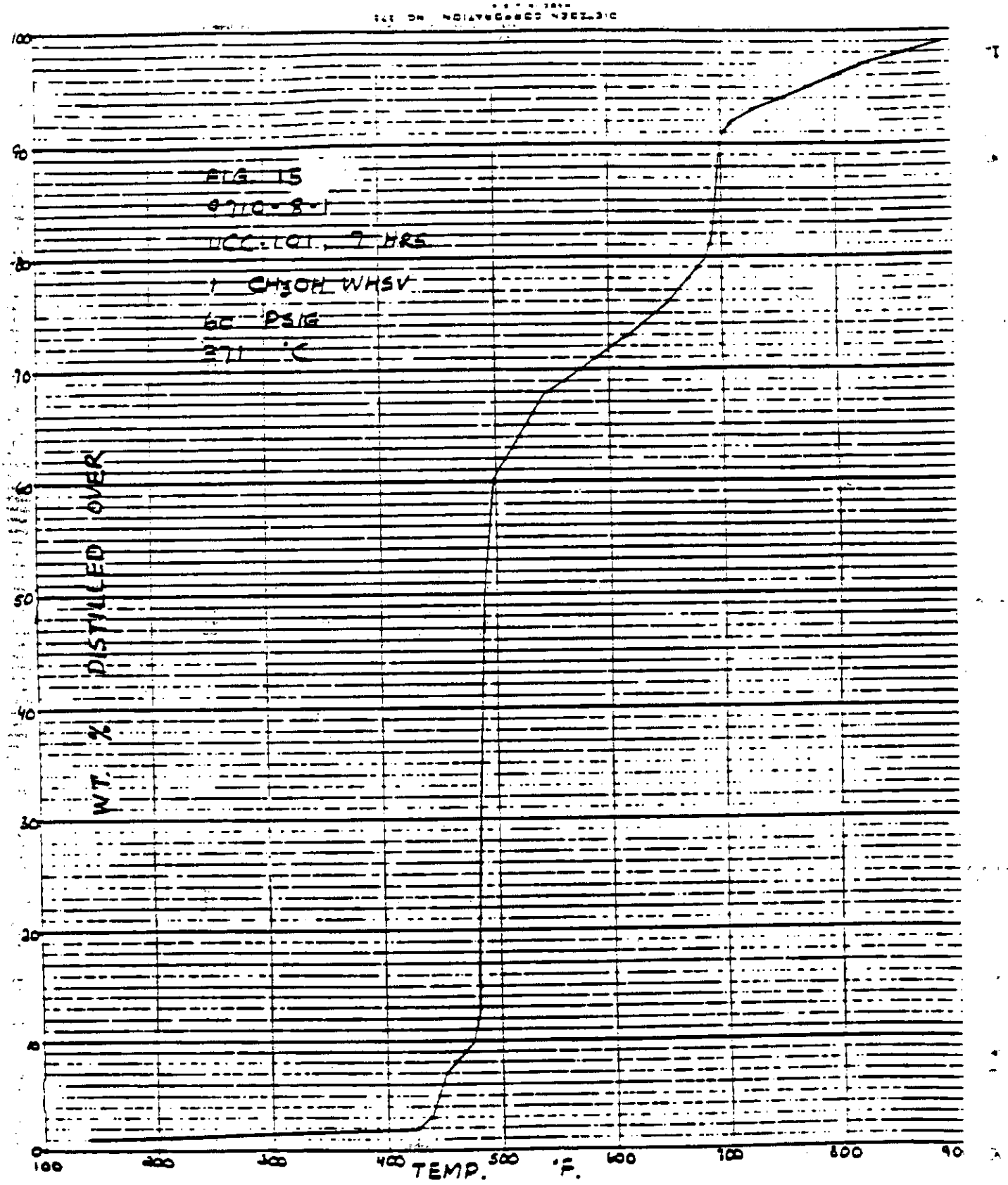


Fig 14
9710-8:A
UCC-101, 2 HRS
CH3OH WHSV
105 PSIG
372 °C
WT. % DISTILLED OVER
TEMP.


FLG 15
97.0-8-1
HCC-101, 7 HRS
1 CH3OH WHSV
60 PSIG
271 °C
% WT. DISTILLED OVER
TEMP. °F.

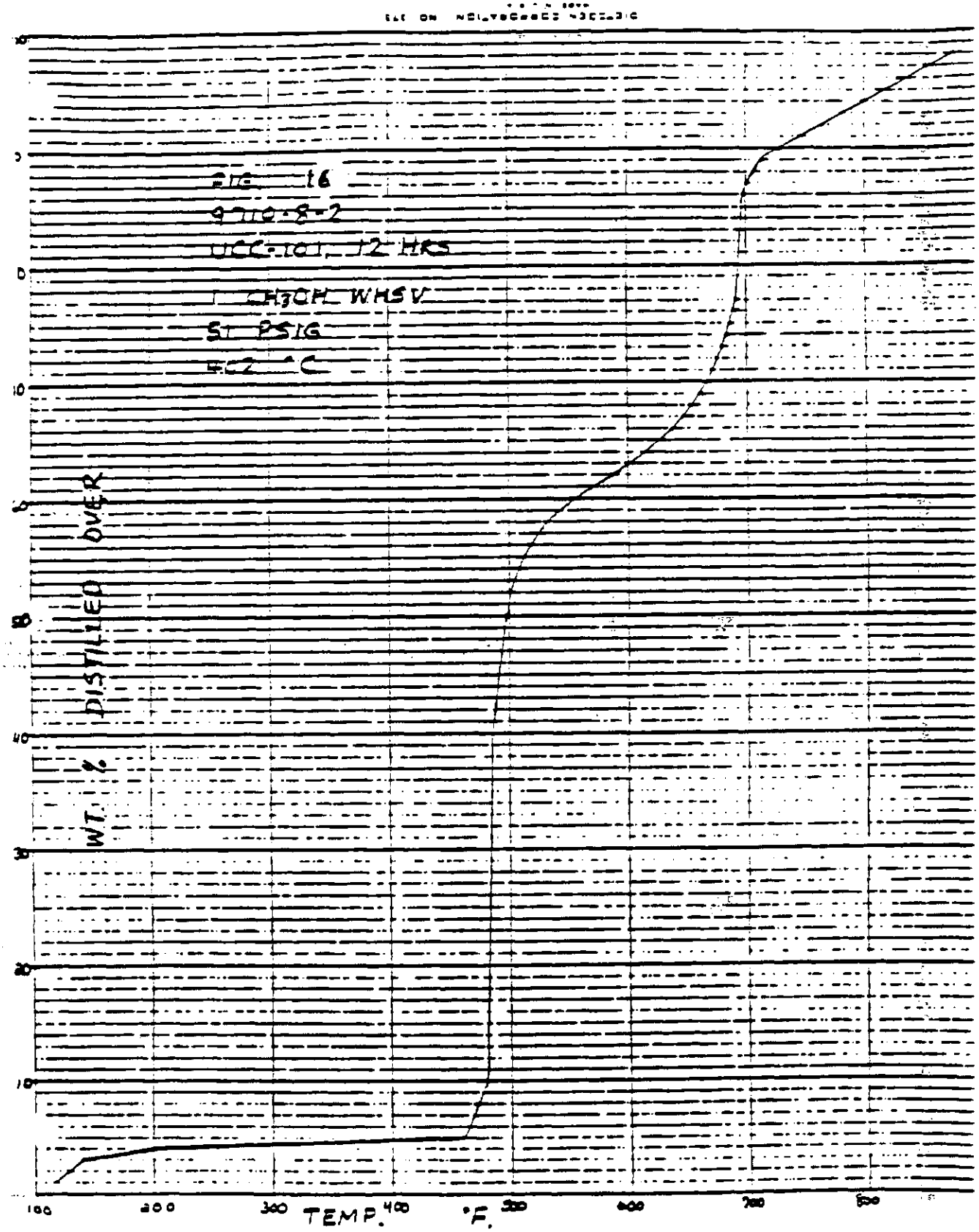


FIG. 16
9710-8-2
UCC-101, 12 HRS
CH3OH WHSV
51 PSIG
462 °C
DISTILLED OVER
WT. %
0
10
20
30
40
50
100
200
300
400
500
600
700
800
TEMP. °F.

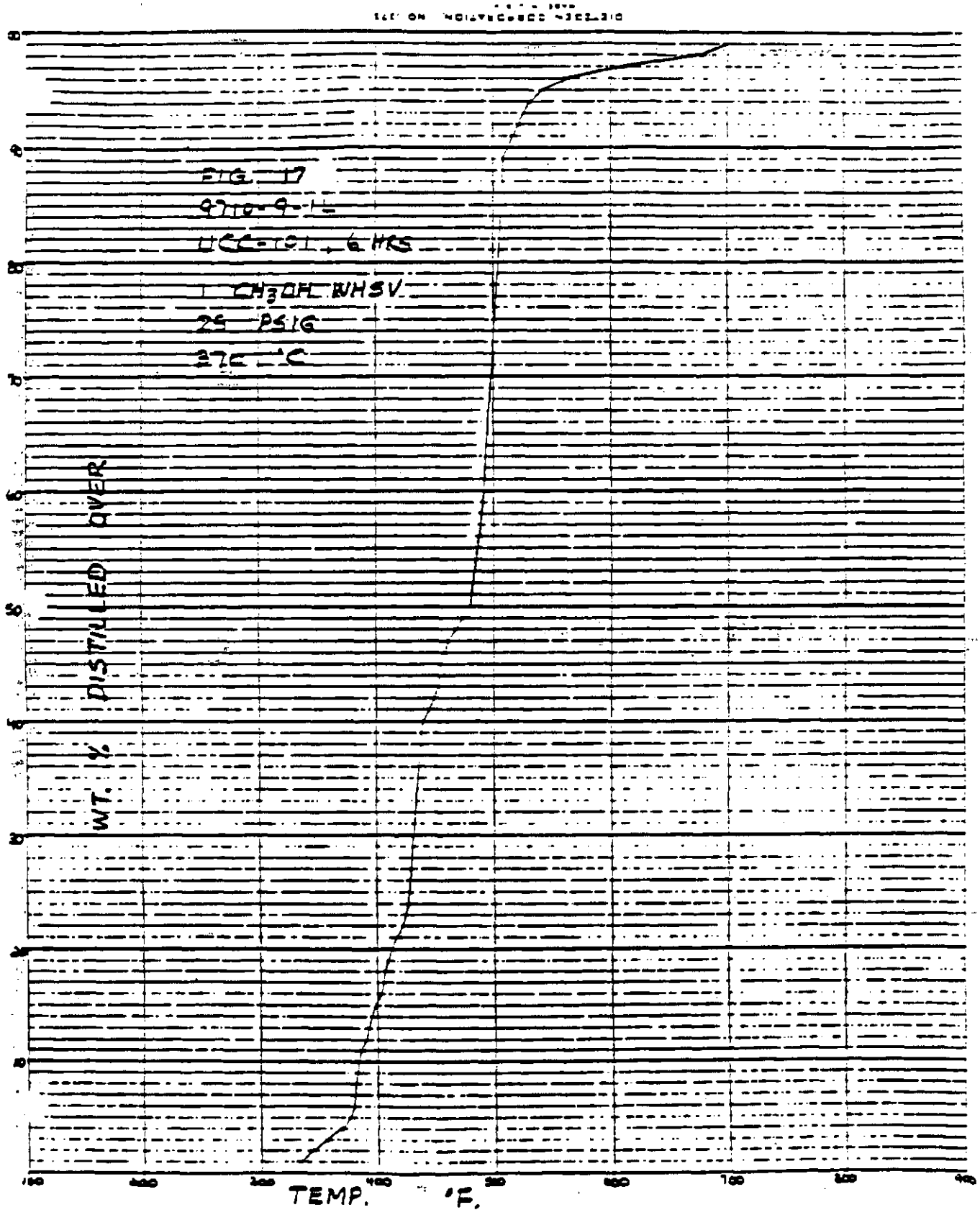


FIG 17
9710-9-1
UCC-G1 + 6 HRS
CH3OH WHSV
25 PSIG
27C °C
DISTILLED OVER
WT. %
TEMP. °F.

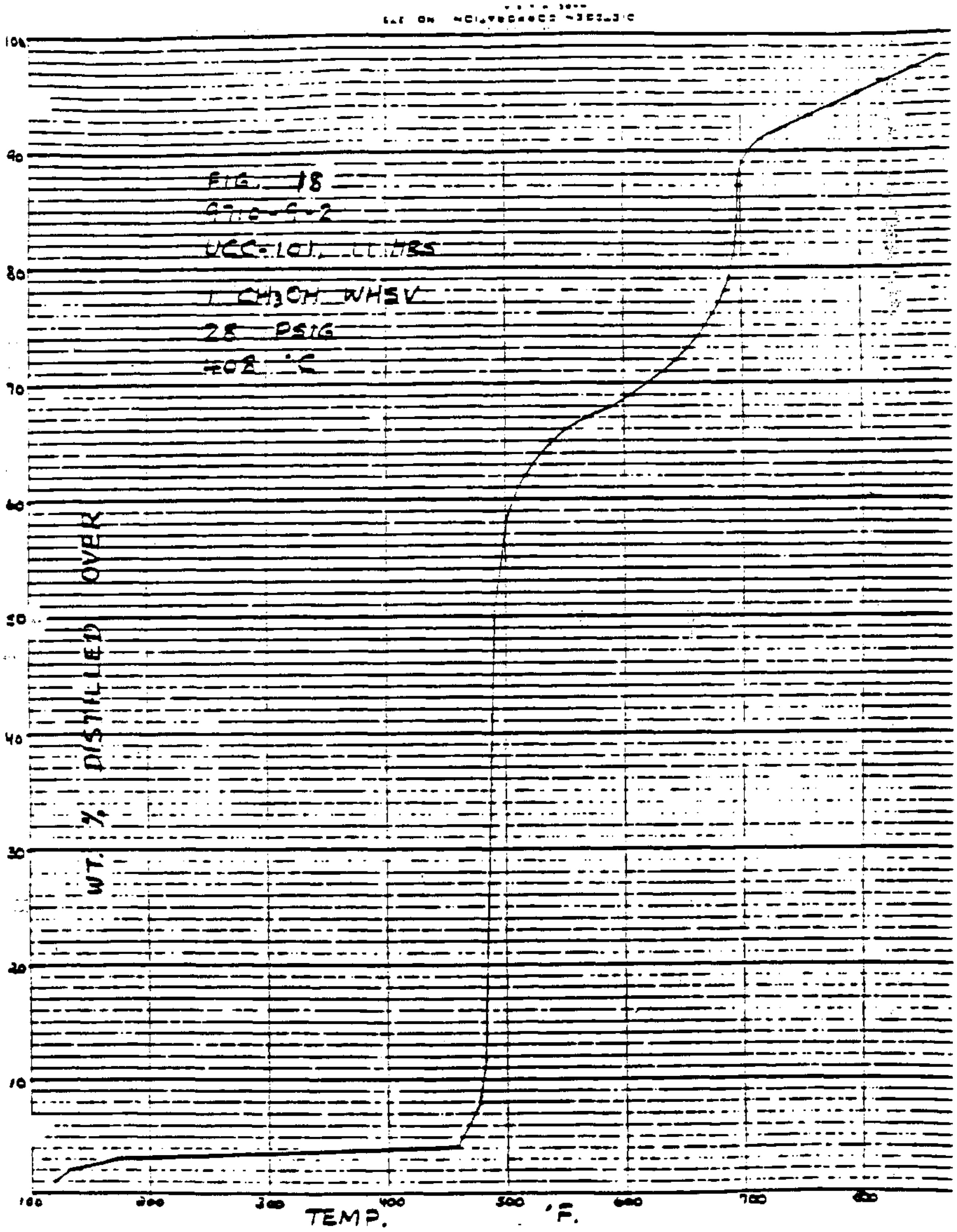


FIG. 18
CH3OH WHSV
28 PSIG
WT. % DISTILLED OVER
TEMP. °F
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800

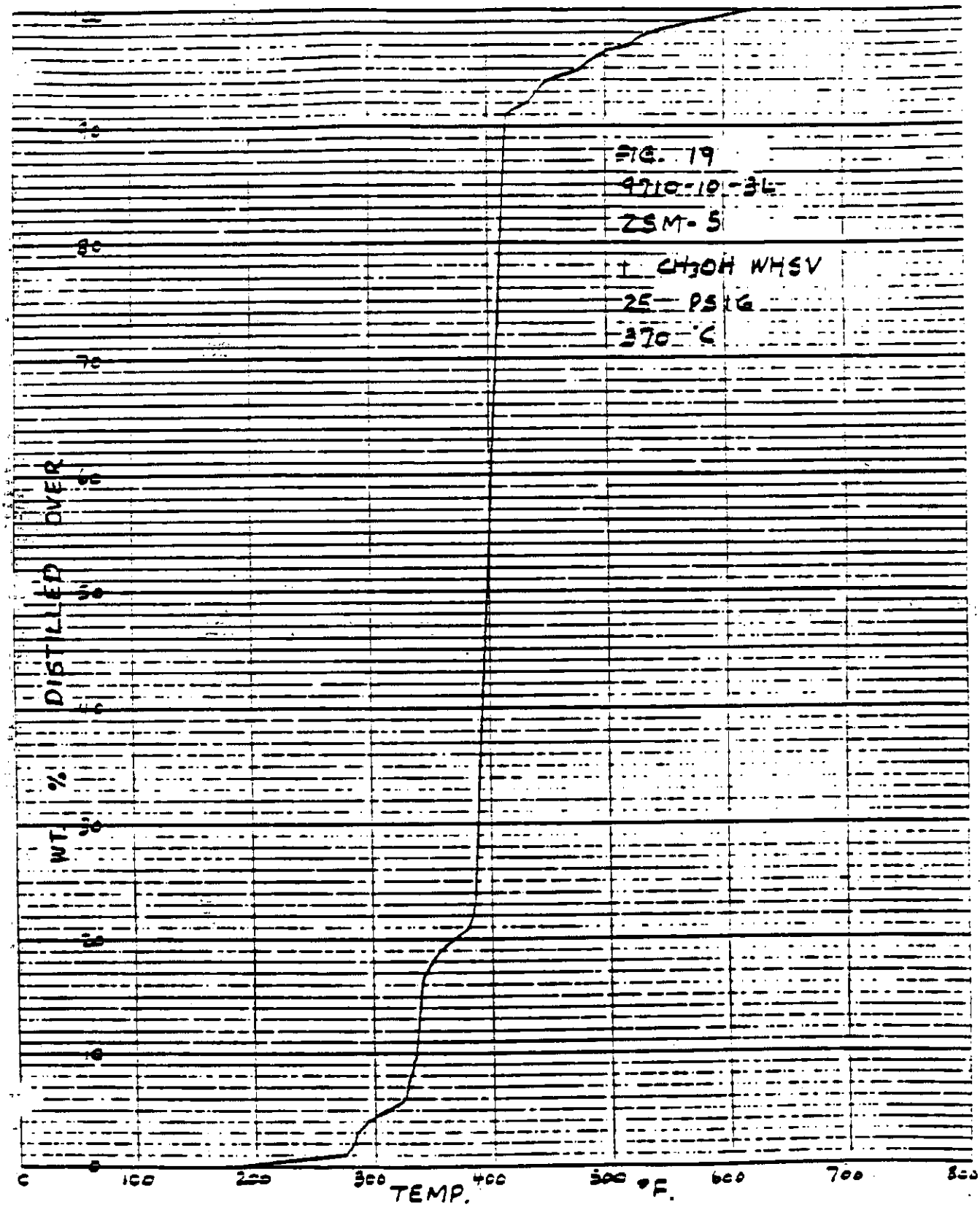


FIG. 19
9210-10-36
ZSM-5
1 CH3OH WHSV
25 PSIG
370 °C
WT. % DISTILLED OVER
TEMP. °F.
C
100
200
300
400
500
600
700
800

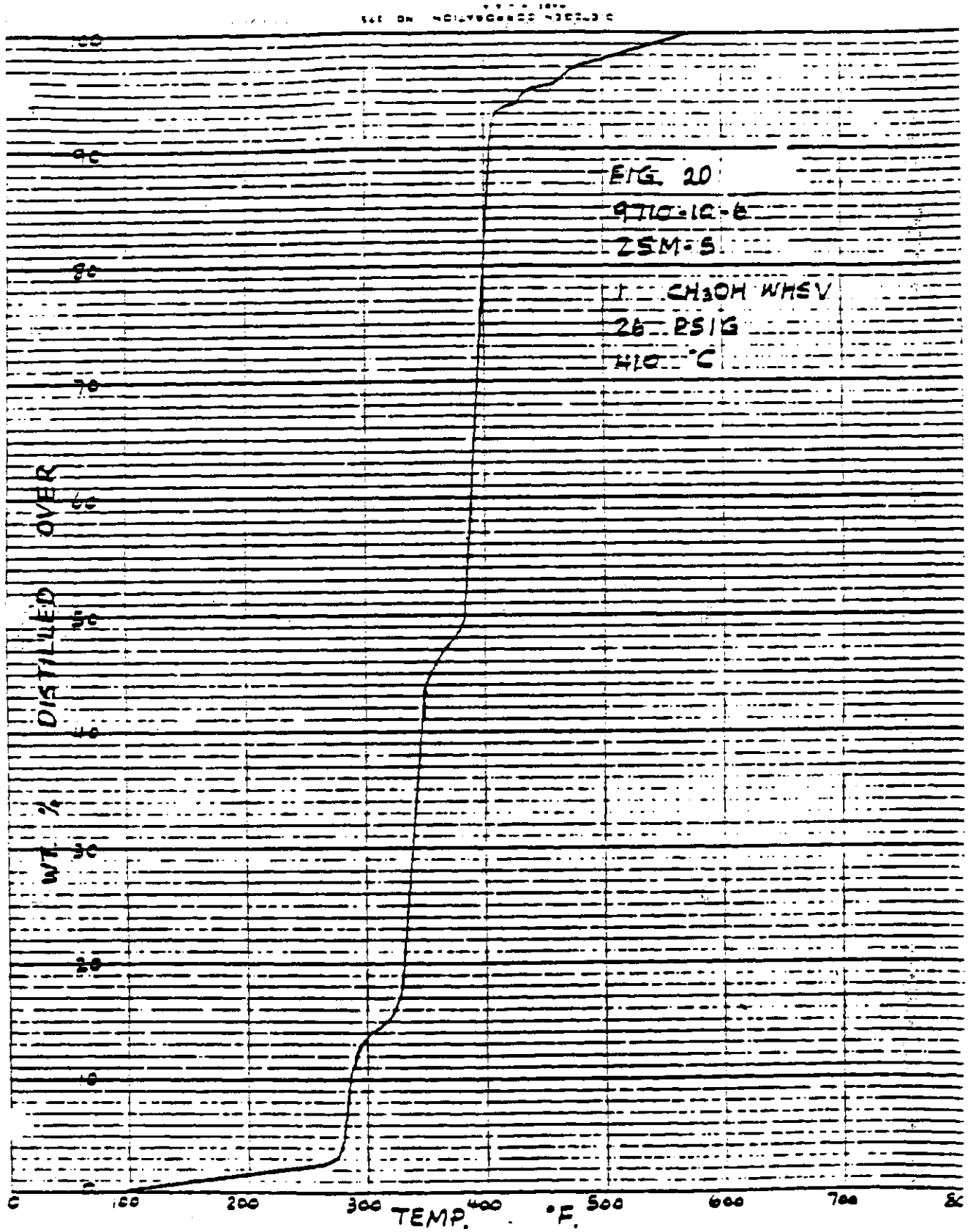


FIG. 20
9710-10-6
ZSM-5
1 CH3OH WHSV
26 PSIG
410 °C
WT % DISTILLED OVER
TEMP. °F.
100
200
300
400
500
600
700

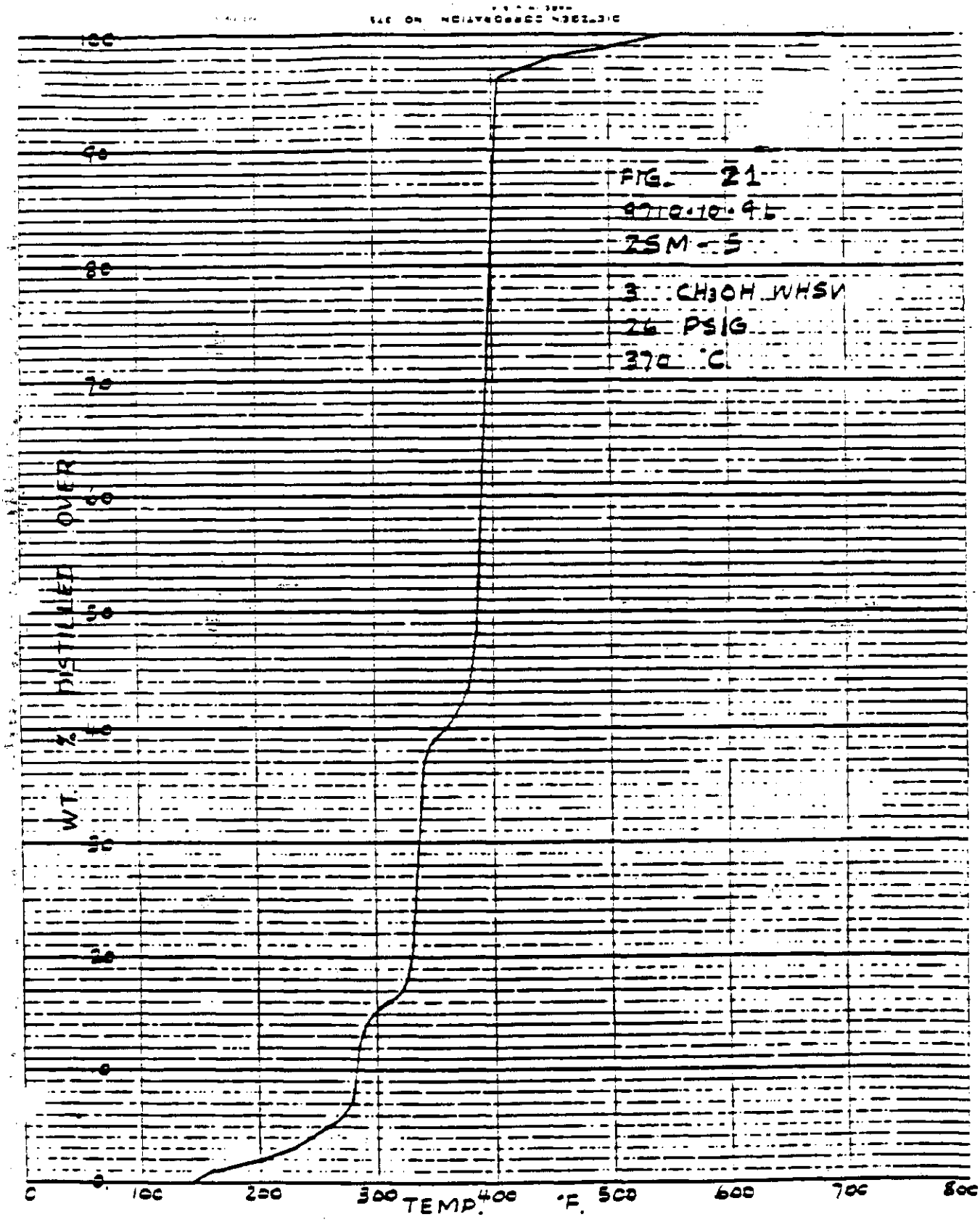


FIG. 21
9710-10-95
ZSM-5
3 CH3OH WHSV
26 PSIG
370 °C
WT. % DISTILLED OVER
TEMP. °F.
0
100
200
300
400
500
600
700
800
10
20
30
40
50
60
70
80
90
100

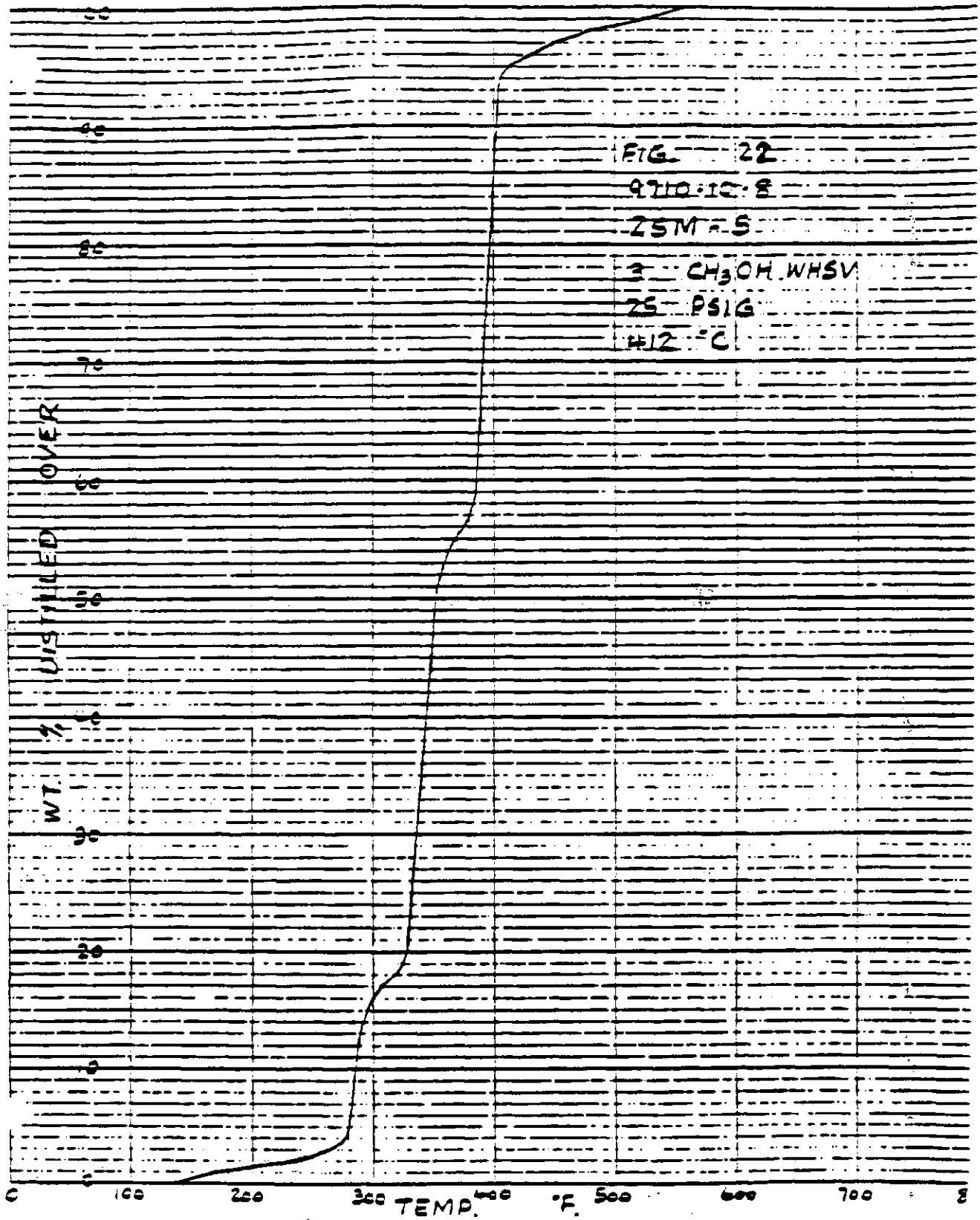


FIG. 22
9710-IC-8
ZSM-5
3 CH_3OH WHSV
25 PSIG
412 °C
DISTILLED OVER
WT. %
TEMP. °F.
100
200
300
400
500
600
700

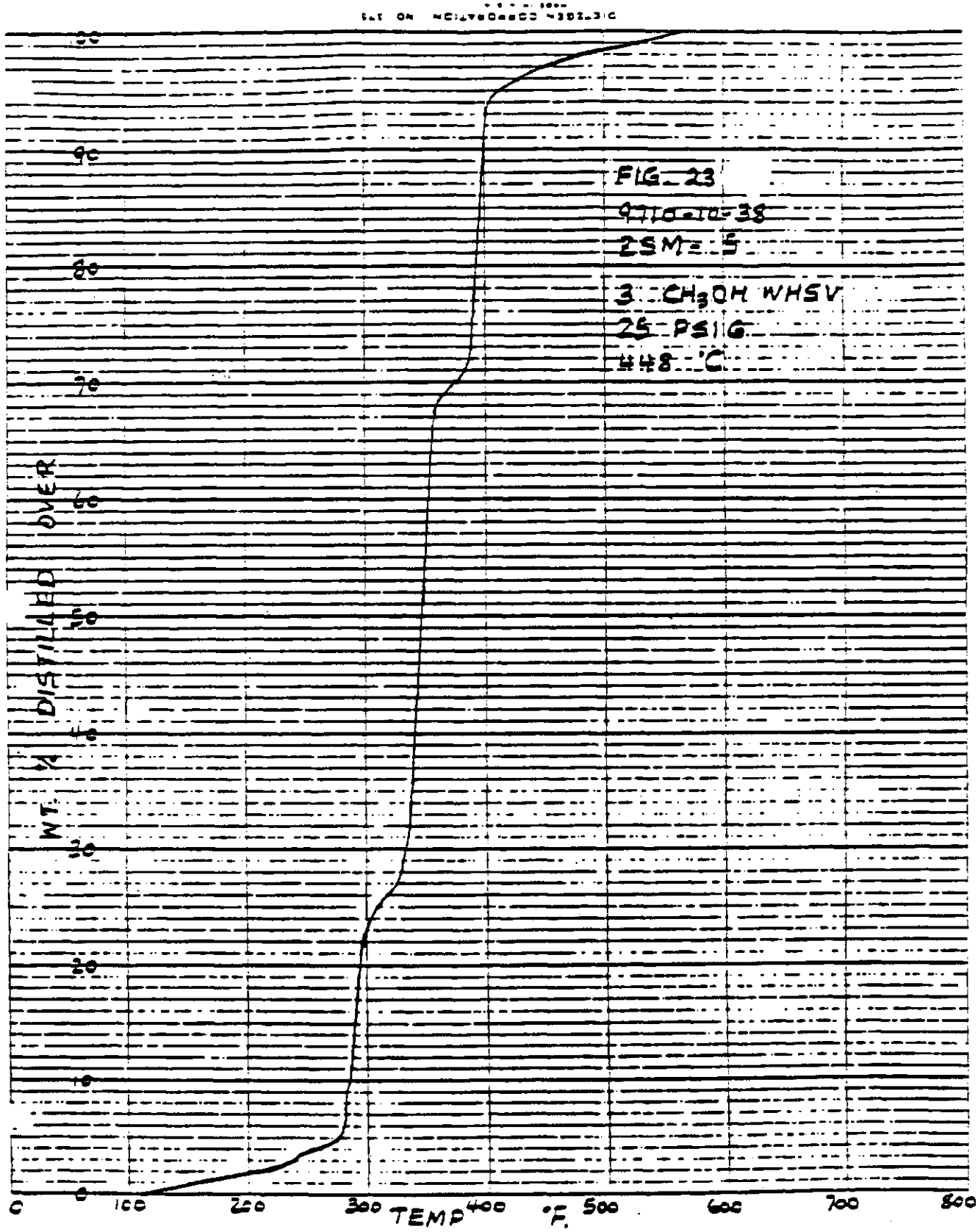


FIG 23
9710-10-38
ZSM-5
3 CH3OH WHSV
25 PSIG
448 °C
WT % DISTILLED OVER
TEMP °F.
0
100
200
300
400
500
600
700
800
10
20
30
40
50
60
70
80
90

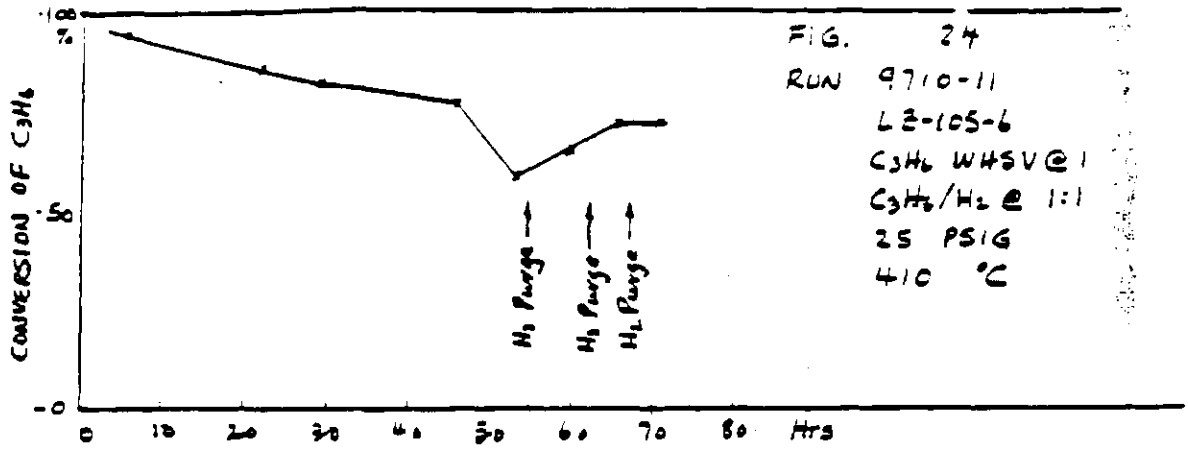
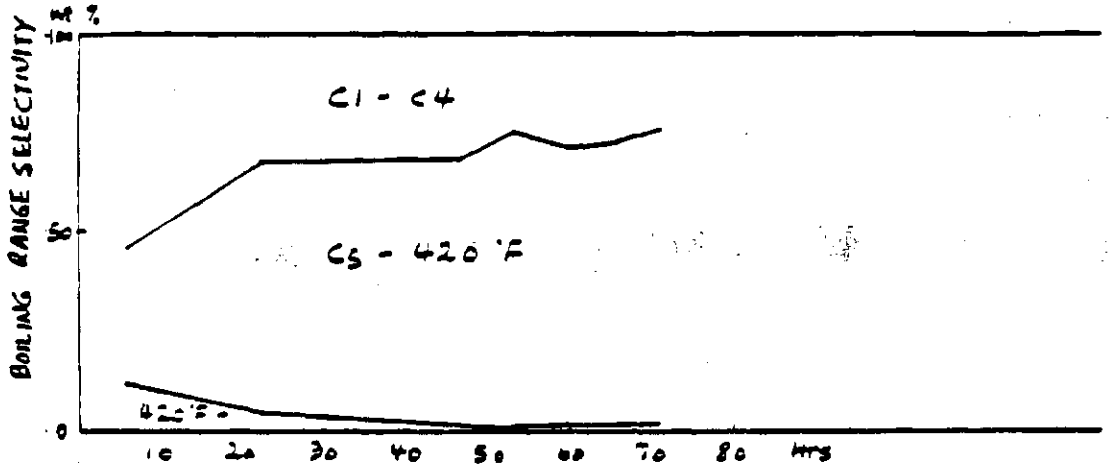
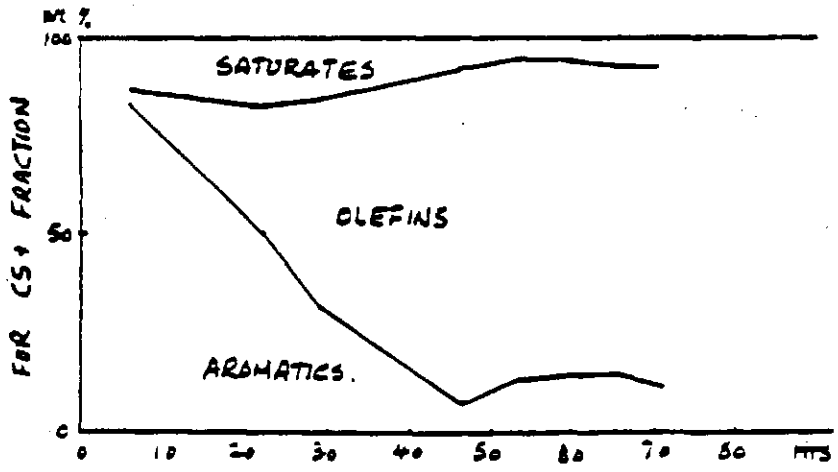
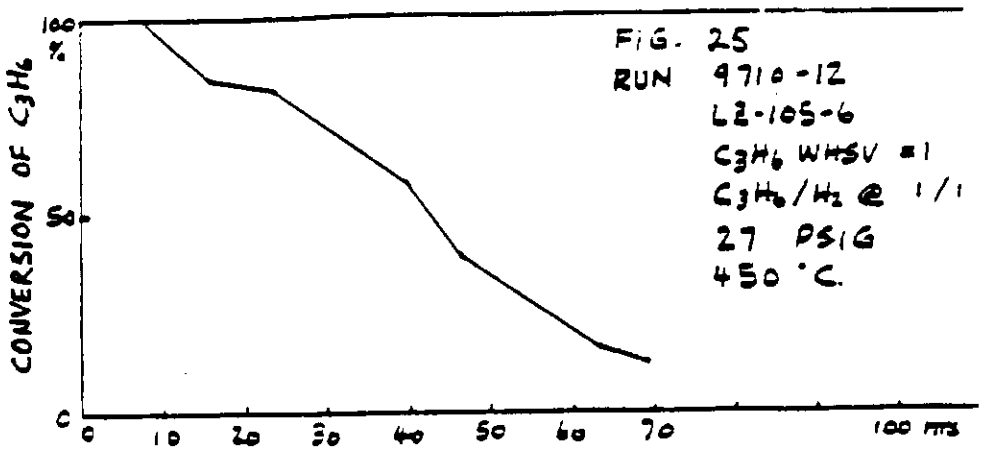
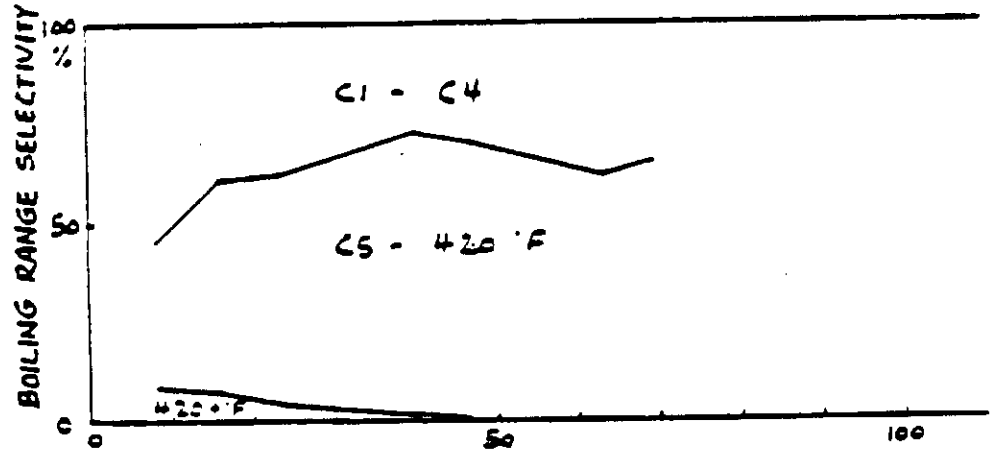


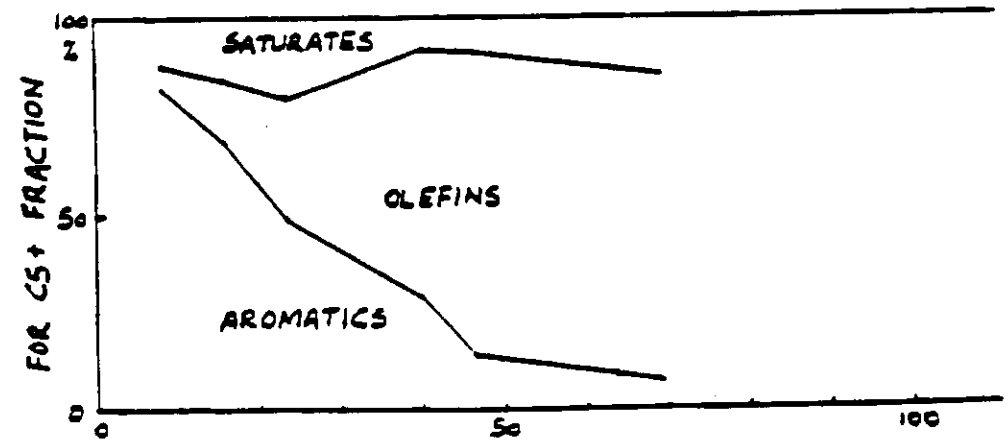
FIG. 24
RUN 9710-11
L2-105-6
C_3H_6 WHSV @ 1
C_3H_6/H_2 @ 1:1
25 PSIG
410 °C

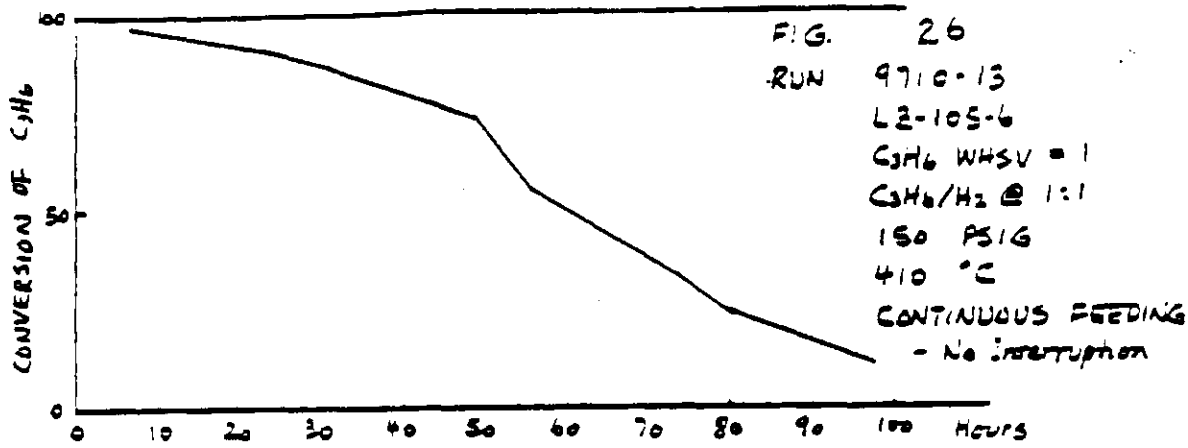


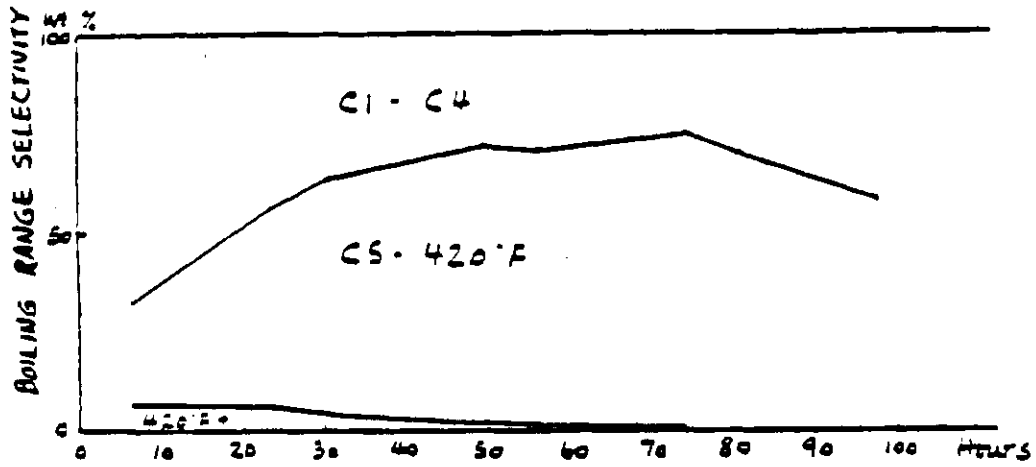



CONVERSION OF C_3H_6
100 %
50
0
0
10
20
30
40
50
60
70
100 mts
FIG. 25
RUN 9710-12
L2-105-6
C_3H_6 WHSV = 1
C_3H_6/H_2 @ 1/1
27 PSIG
450 °C.


BOILING RANGE SELECTIVITY
100 %
50
0
C1 - C4
C5 - 420 °F
420 °F
0
50
100


FOR C5+ FRACTION
100 %
50
0
SATURATES
OLEFINS
AROMATICS
0
50
100


CONVERSION OF C_3H_6
100
50
0
0 10 20 30 40 50 60 70 80 90 100 Hours
FIG. 26
RUN 9710-13
L2-105-6
C_3H_6 WHSV = 1
C_3H_6/H_2 @ 1:1
150 PSIG
410 °C
CONTINUOUS FEEDING
- No Interruption


BOILING RANGE SELECTIVITY
Wt %
100
50
0
C1 - C4
C5 - 420°F
0 10 20 30 40 50 60 70 80 90 100 Hours

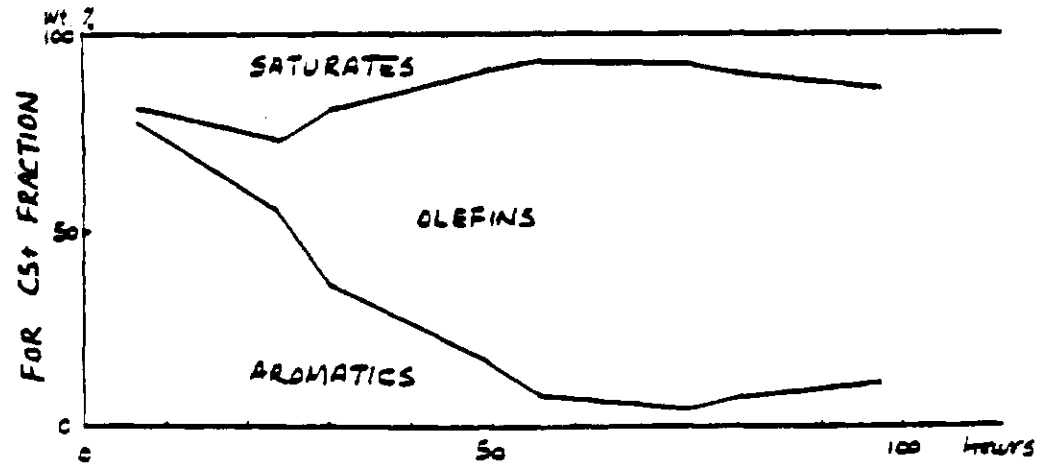

FOR C5+ FRACTION
Wt %
100
50
0
SATURATES
OLEFINS
AROMATICS
0 50 100 Hours

FIGURE 27
CATALYST UCC-101

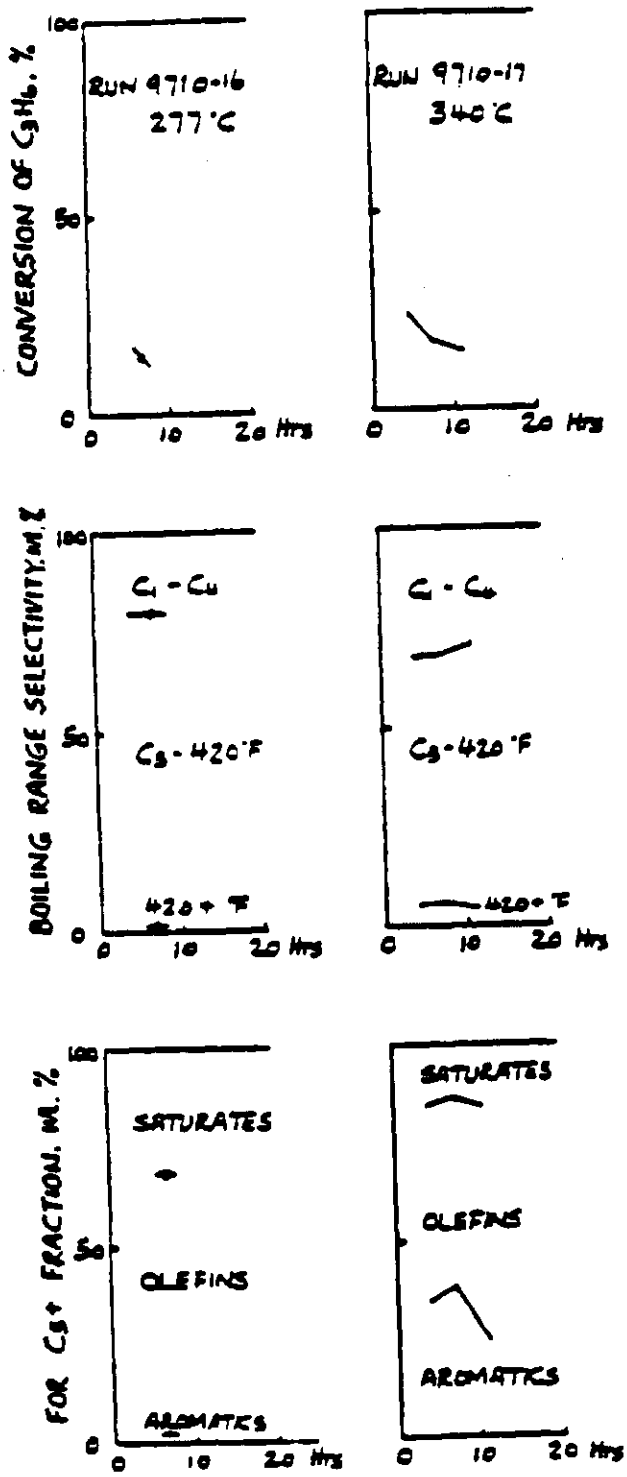
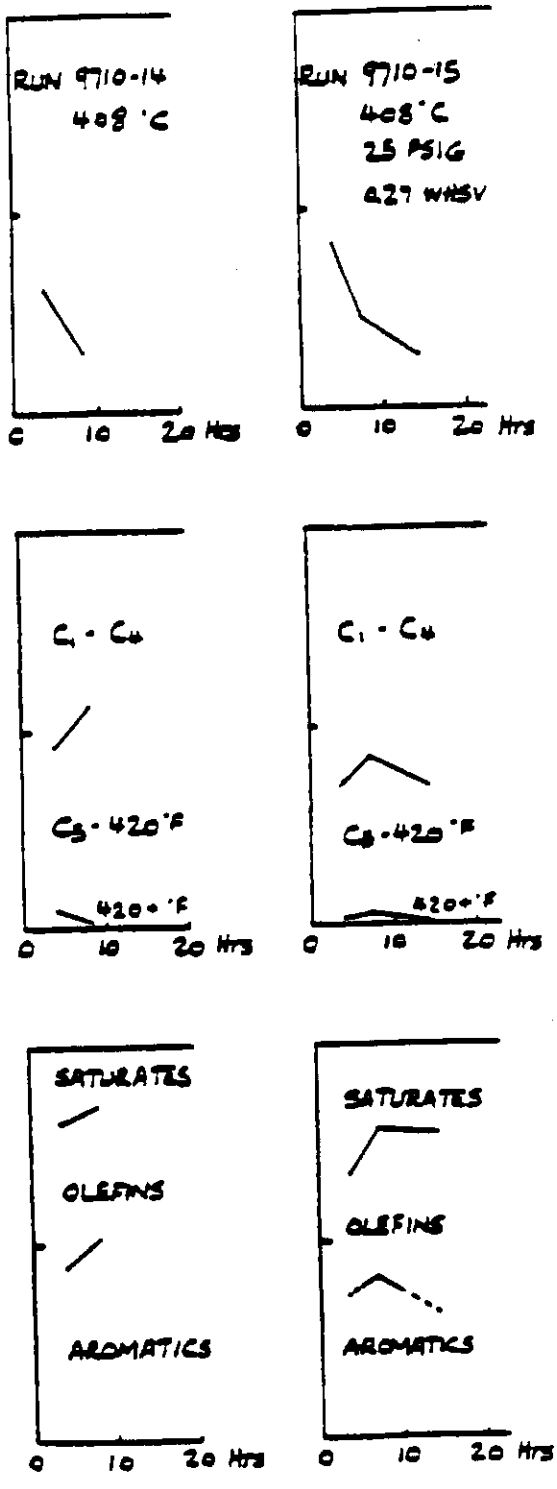


FIGURE 28
UCC-101



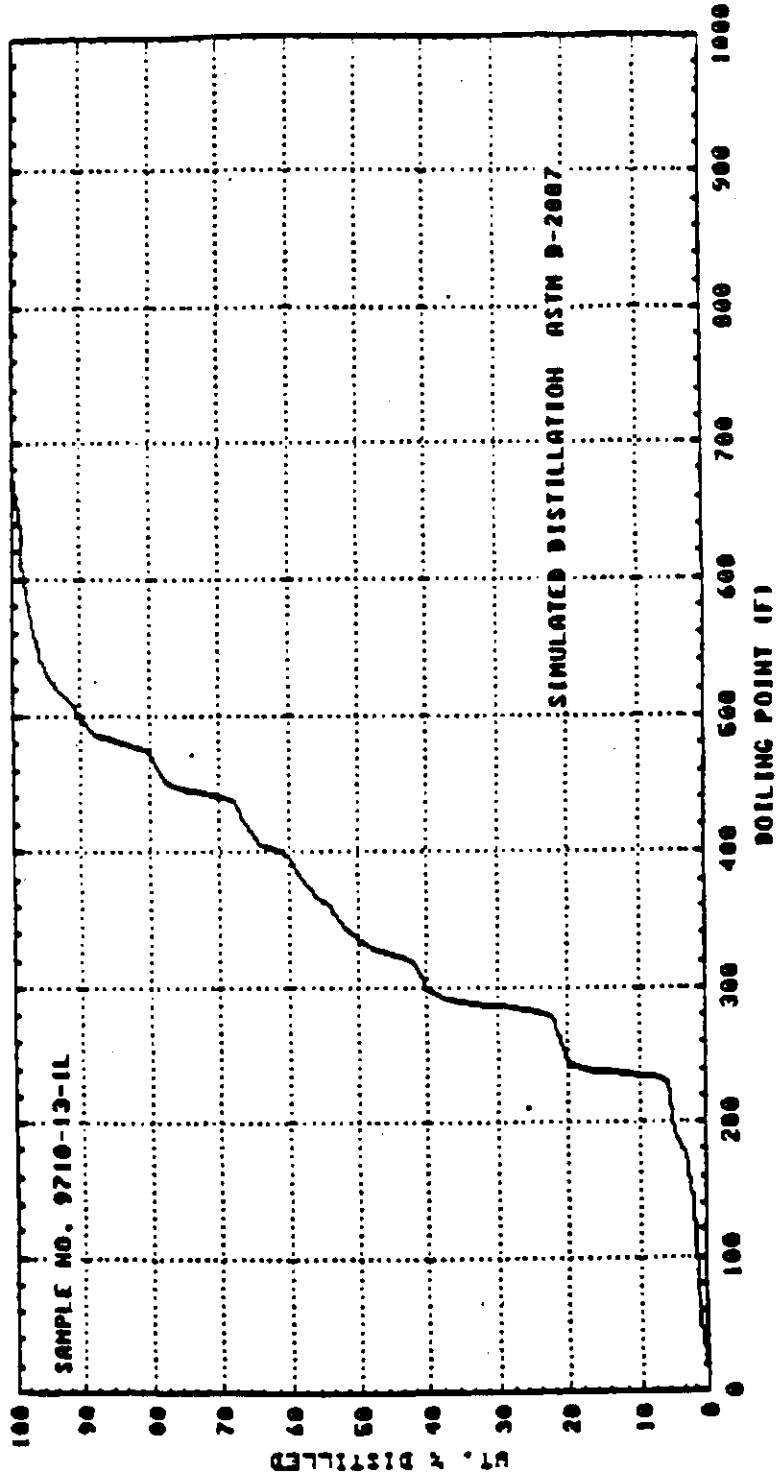

SAMPLE NO. 9710-13-IL
SIMULATED DISTILLATION ASTM D-2887
BOILING POINT (F)
WT. % DISTILLED
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

FIG. 29

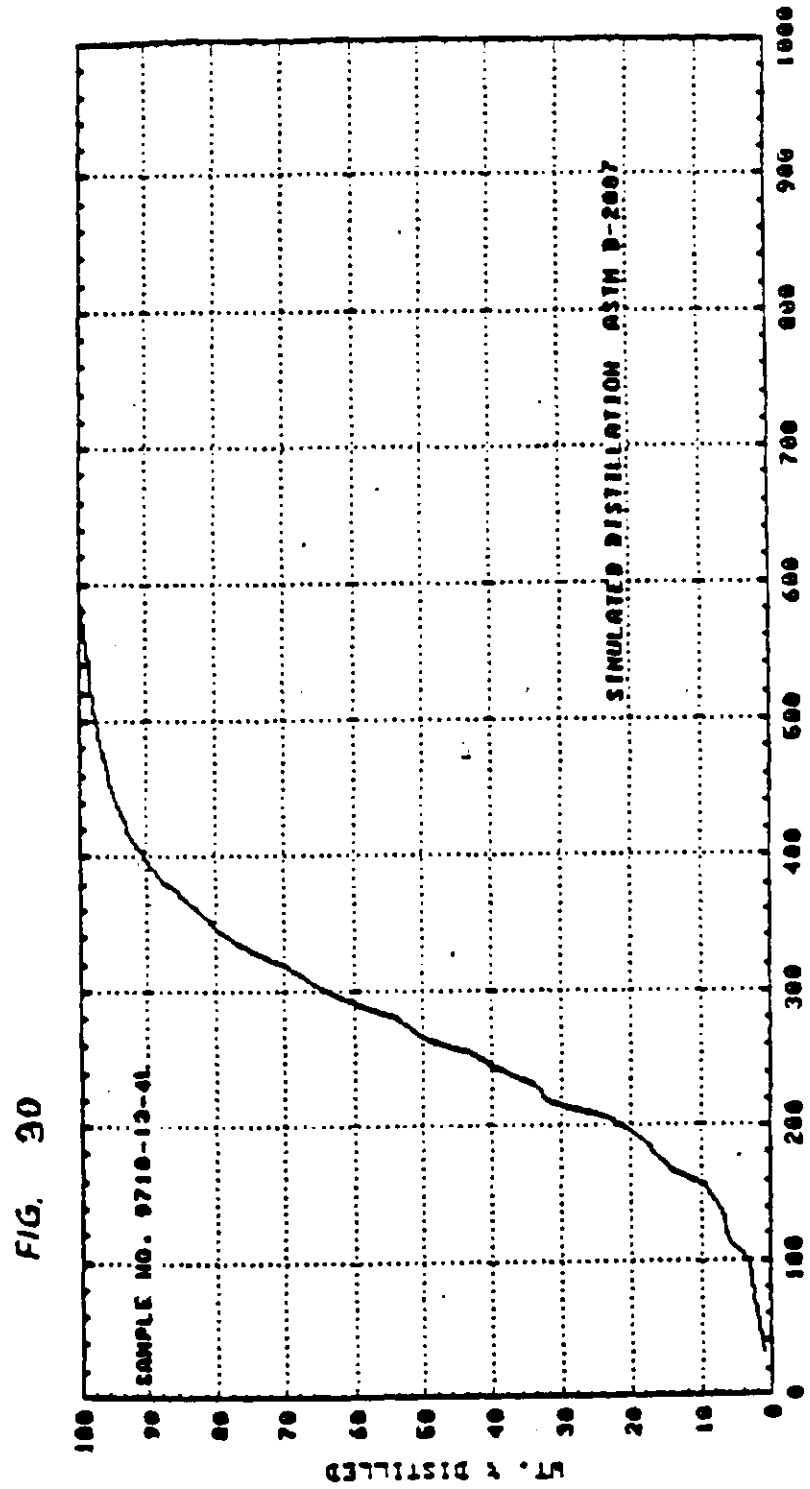
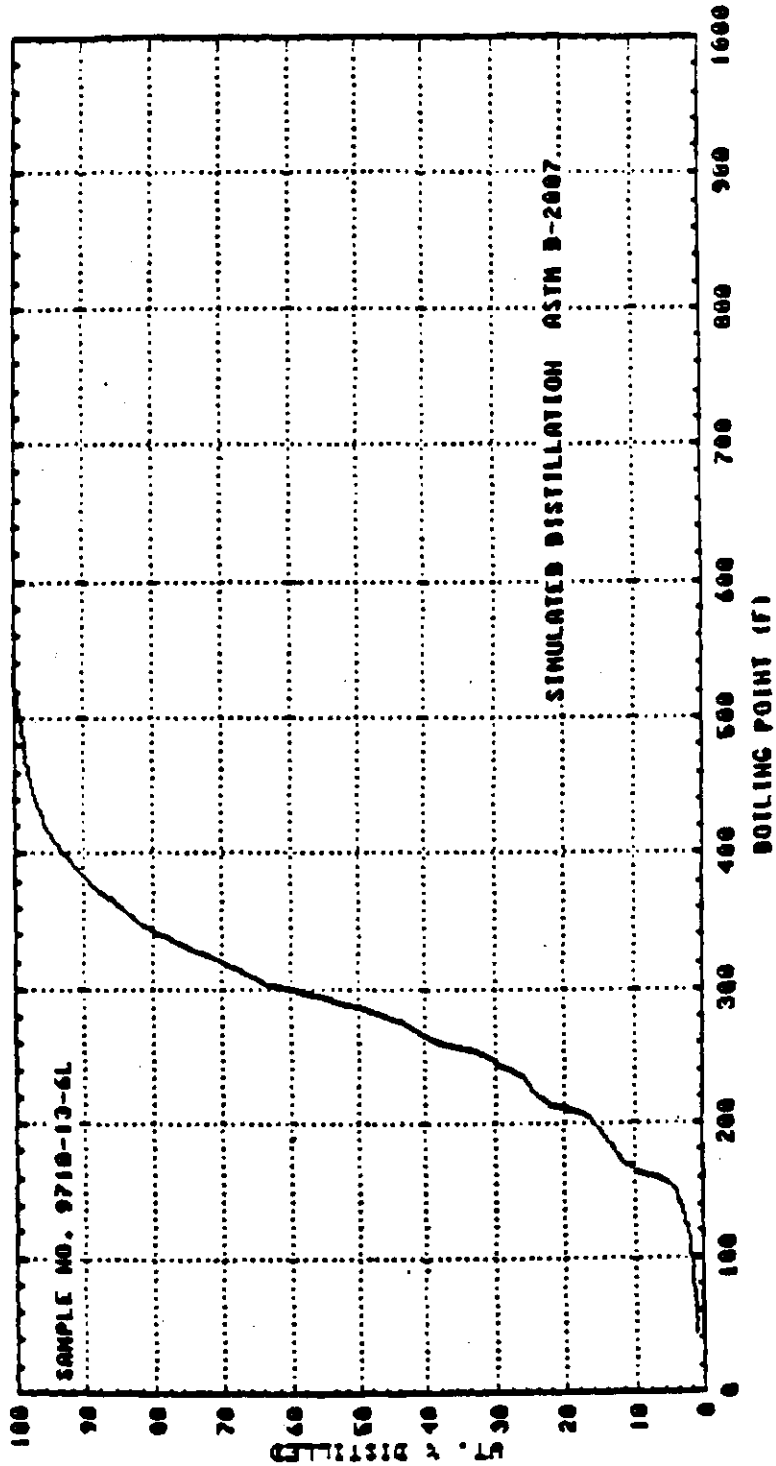

SAMPLE NO. 9710-13-4L
SIMULATED DISTILLATION ASTM D-2887
WT. % DISTILLED
BOILING POINT (F)
100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
1000

FIG. 30

FIG. 31


SAMPLE NO. 9710-13-6L
SIMULATED DISTILLATION ASTM D-2887
BOILING POINT (F)
WT. % DISTILLED
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

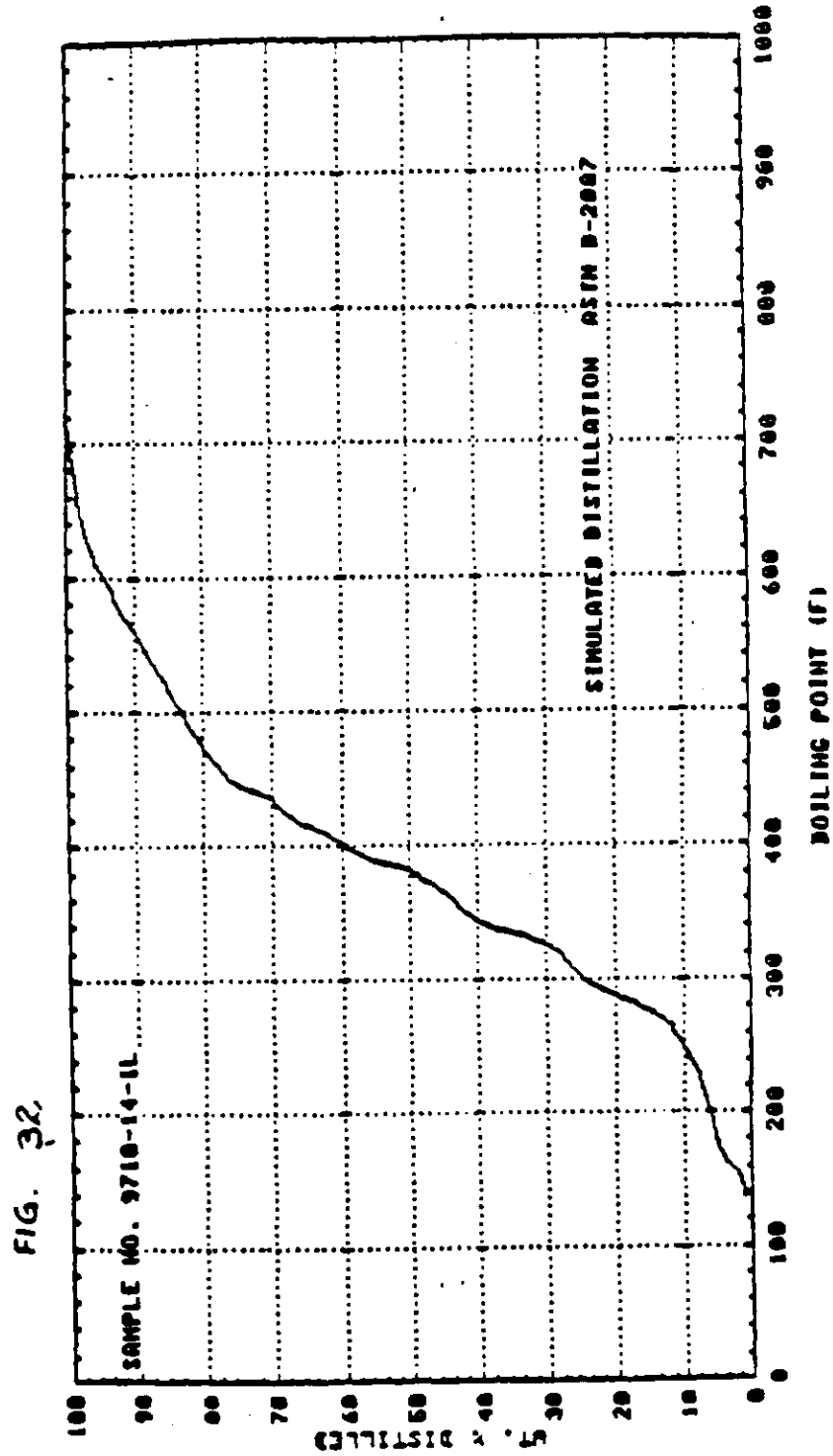

SAMPLE NO. 9710-14-IL
SIMULATED DISTILLATION ASTM D-2887
BOILING POINT (F)
% DISTILLED
0
100
200
300
400
500
600
700
800
900
1000
10
20
30
40
50
60
70
80
90
100

FIG. 32

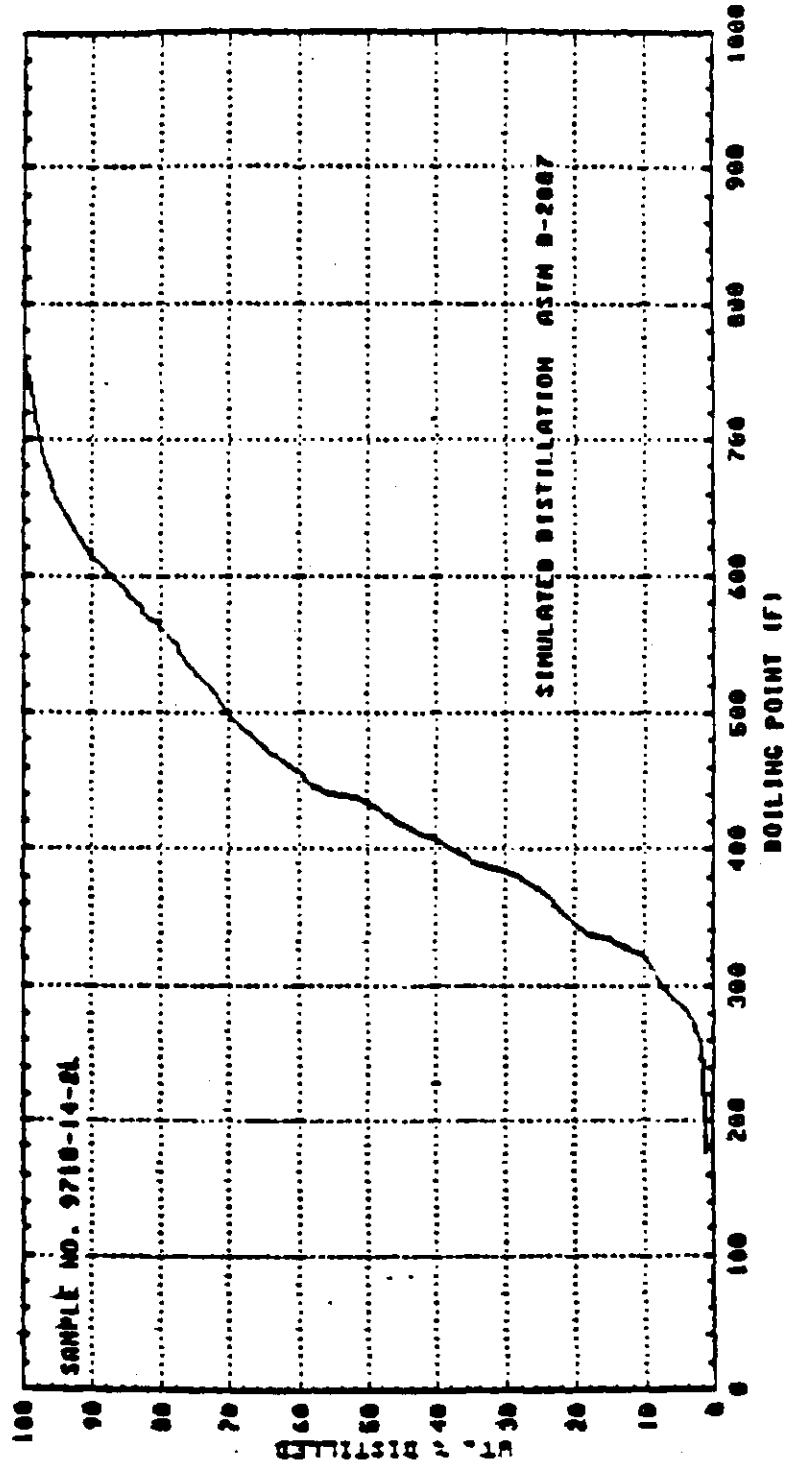
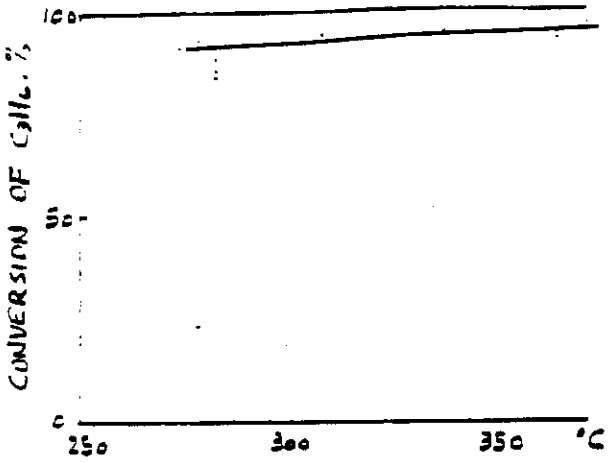
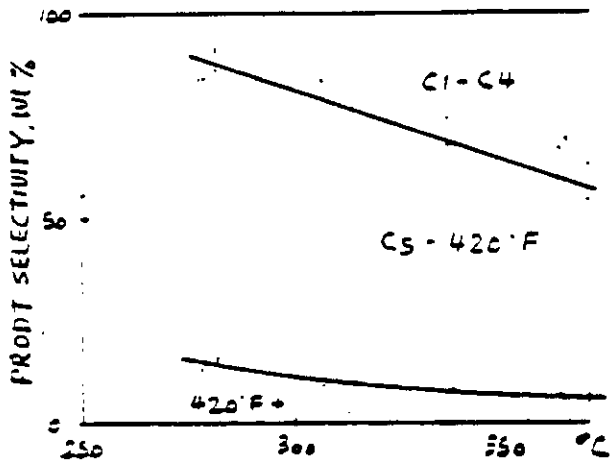

SAMPLE NO. 9710-14-BL
SIMULATED DISTILLATION ASTM D-2887
BOILING POINT (F)
0
100
200
300
400
500
600
700
800
900
1000
100
90
80
70
60
50
40
30
20
10
0

FIG. 33





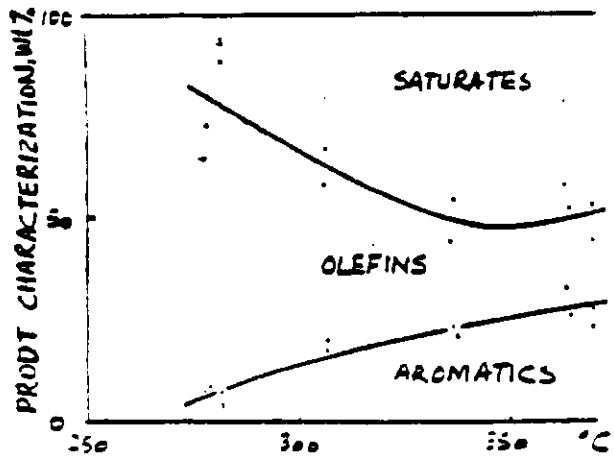


FIGURE 34

EFFECTS OF TEMPERATURE ON PROPYLENE OPERATION WITH LZ-105-6 AT 150 PSIG

RUN 9972-1, LZ-105-6
$H_2:C_3H_6$ @ 1:1
C_3H_6 WHSV = 1.1
150 PSIG

= 6.35 EFFECT OF PRESSURE ON PROPYLENE OPERATION WITH [illegible]

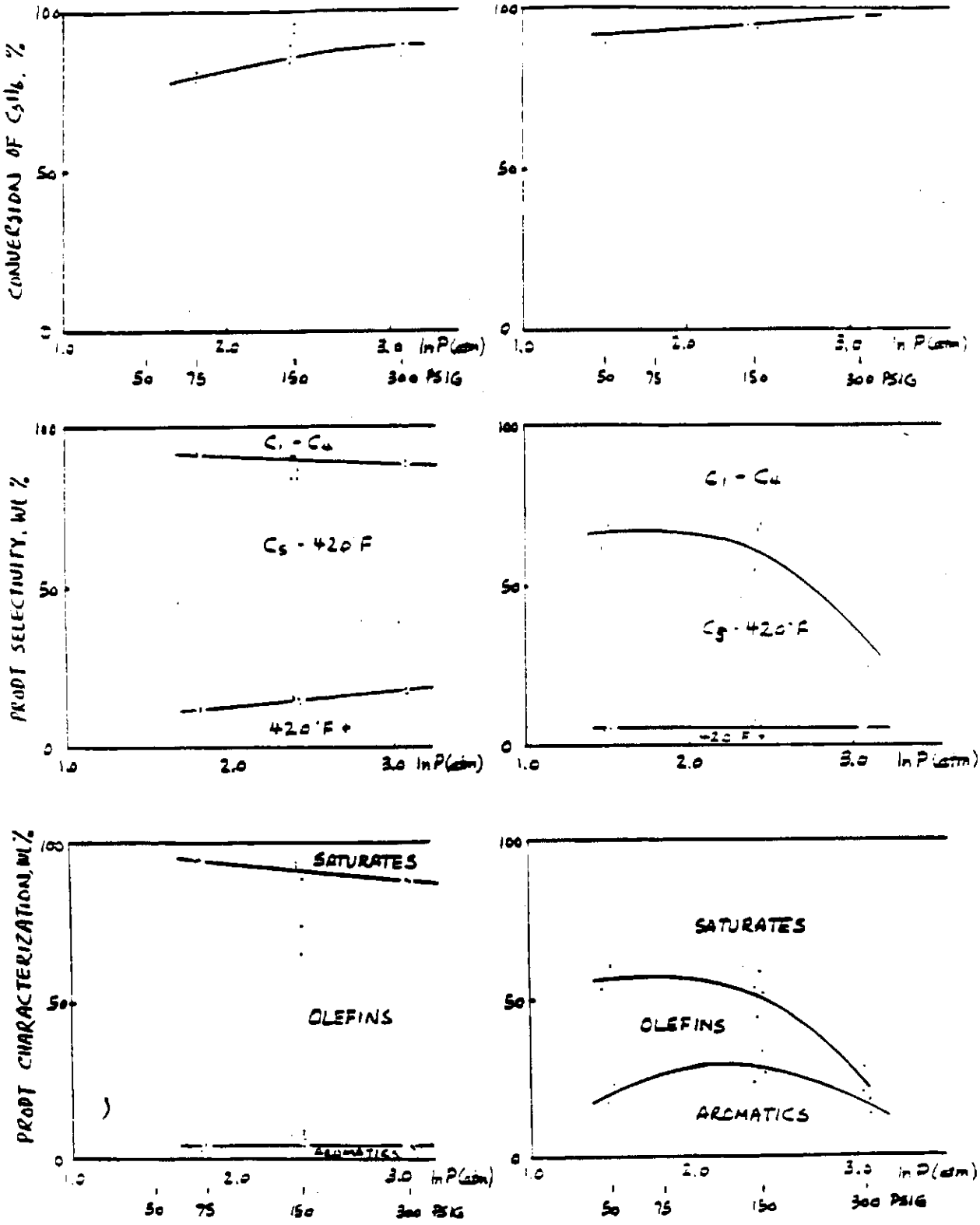


FIGURE 36

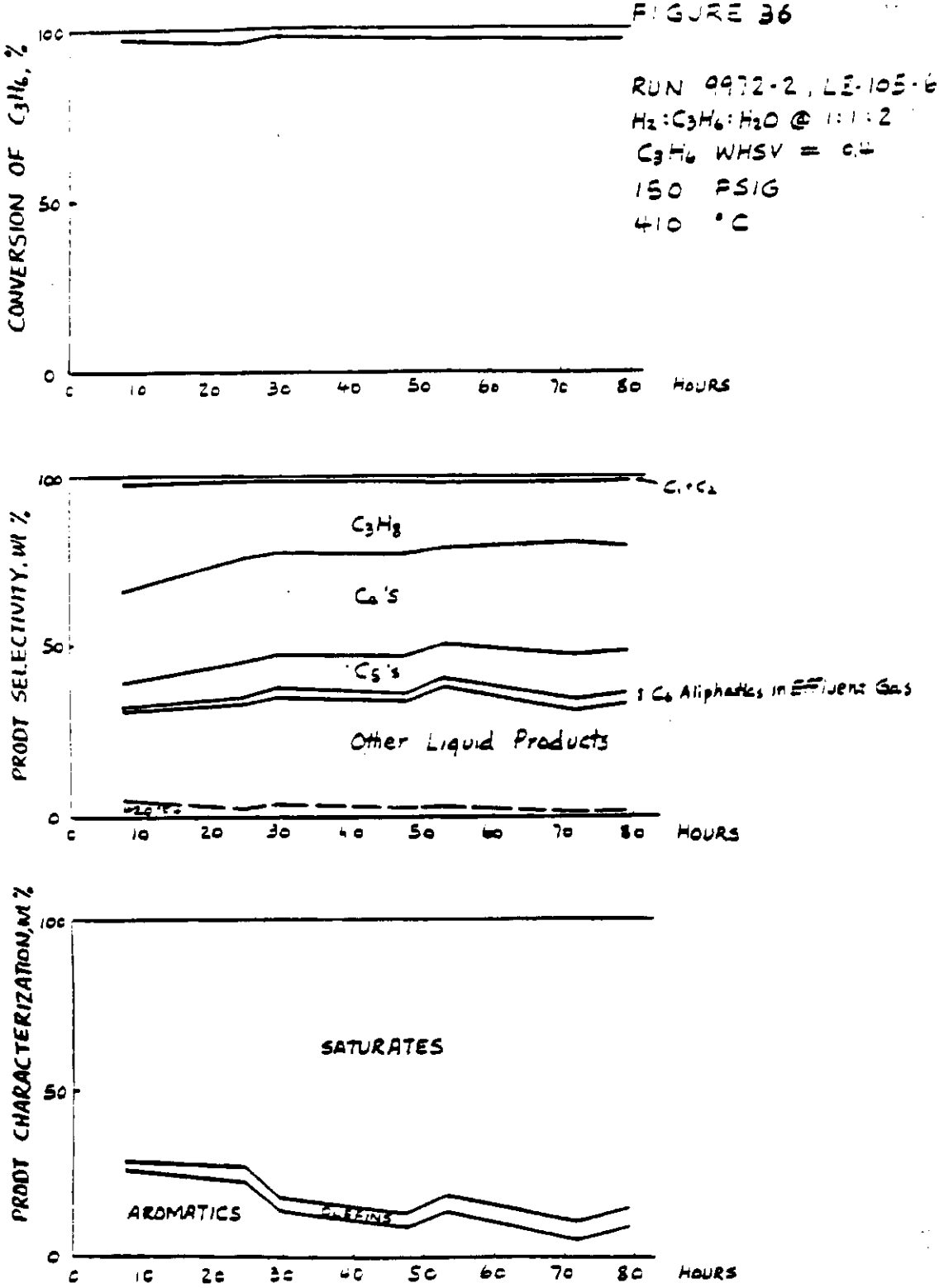

RUN 9972-2, LE-105-6
$H_2:C_3H_6:H_2O$ @ 1:1:2
C_3H_6 WHSV = 0.4
150 PSIG
410 °C
CONVERSION OF C_3H_6, %
100
50
0
0
10
20
30
40
50
60
70
80
HOURS
PRODT SELECTIVITY, WT %
C_1+C_2
C_3H_8
C_4's
C_5's
C_6 Aliphatics in Effluent Gas
Other Liquid Products
HOURS
PRODT CHARACTERIZATION, WT %
SATURATES
AROMATICS
OLEFINS
HOURS

FIGURE 37

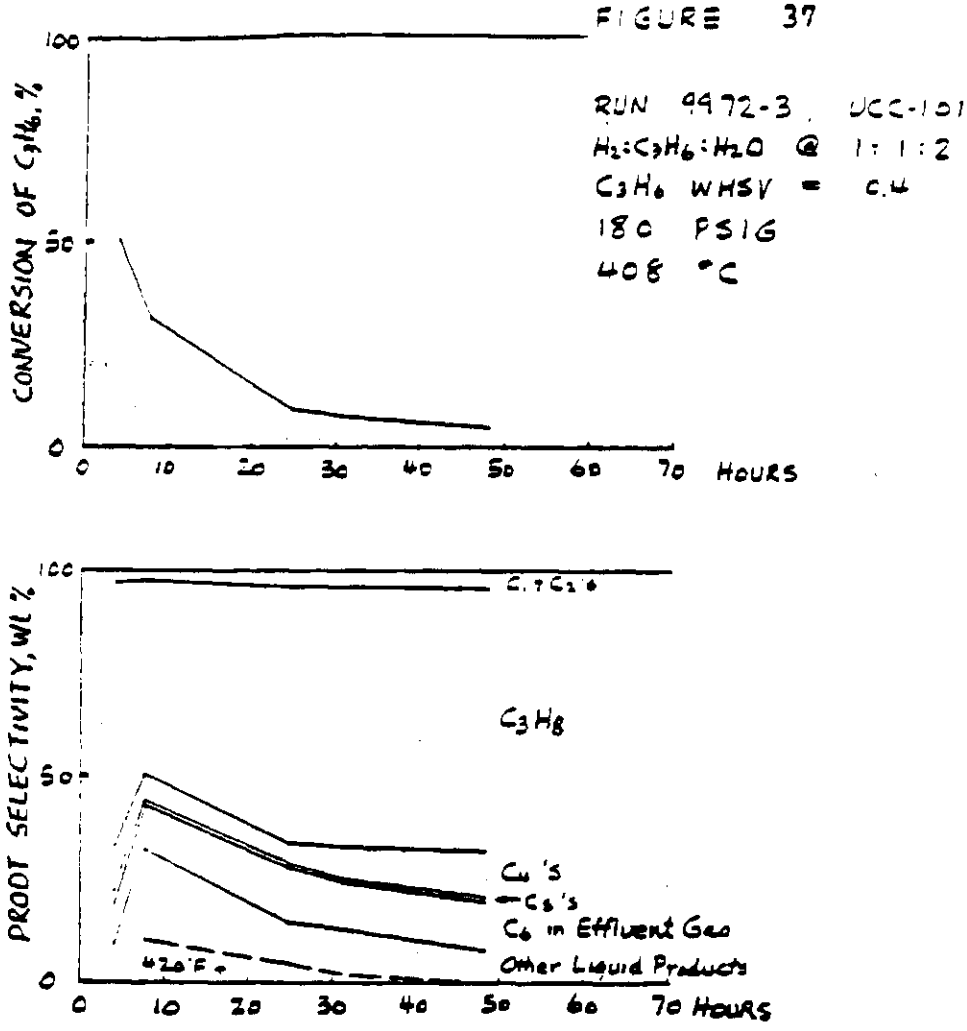
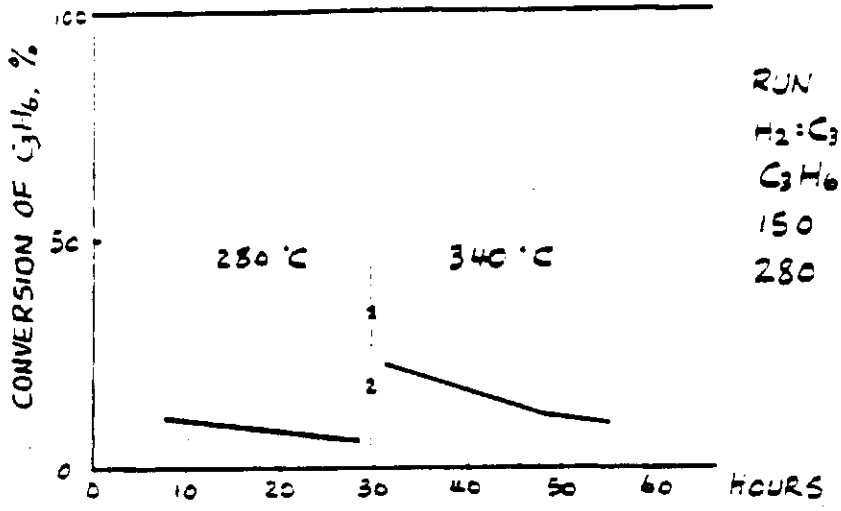

RUN 9972-3, UCC-101
$H_2:C_3H_6:H_2O$ @ 1:1:2
C_3H_6 WHSV = 0.4
180 PSIG
408 °C
CONVERSION OF C_3H_6, %
100
50
0
0 10 20 30 40 50 60 70 HOURS
PRODT SELECTIVITY, WT %
100
50
0
C. + C_2's
C_3H_8
C_4's
C_5's
C_6 in Effluent Gas
Other Liquid Products
420°F +
0 10 20 30 40 50 60 70 HOURS

FIGURE 38

RUN 9972-4, UCC-101
$H_2:C_3H_6:H_2O$ @ 1:1:3
C_3H_6 WHSV = 0.4
150 PSIG
280 & 340 °C



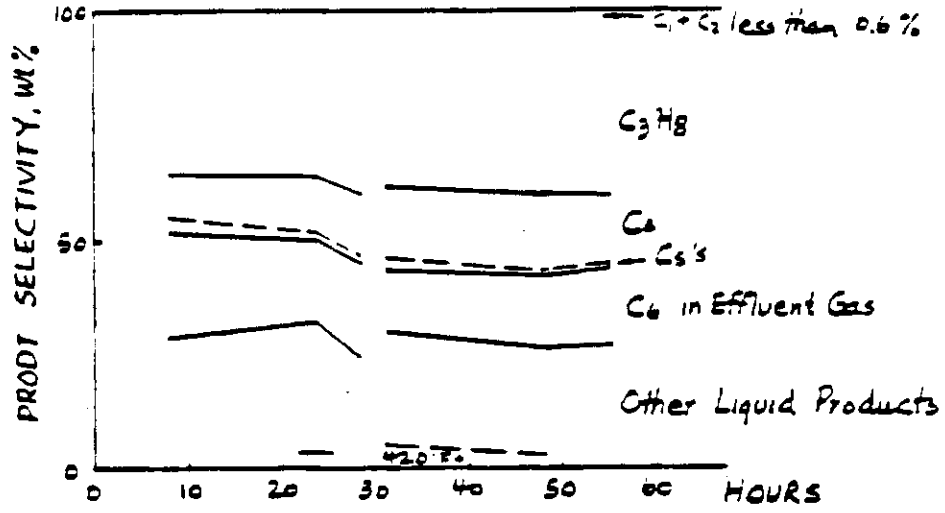


FIGURE 39

RUN 9972-3, -4
UCC-101
$H_2 : C_3H_6 : H_2O$ @ 1:1:2
1:1:3
150 - 180 PSIG
INITIAL CONVERSIONS

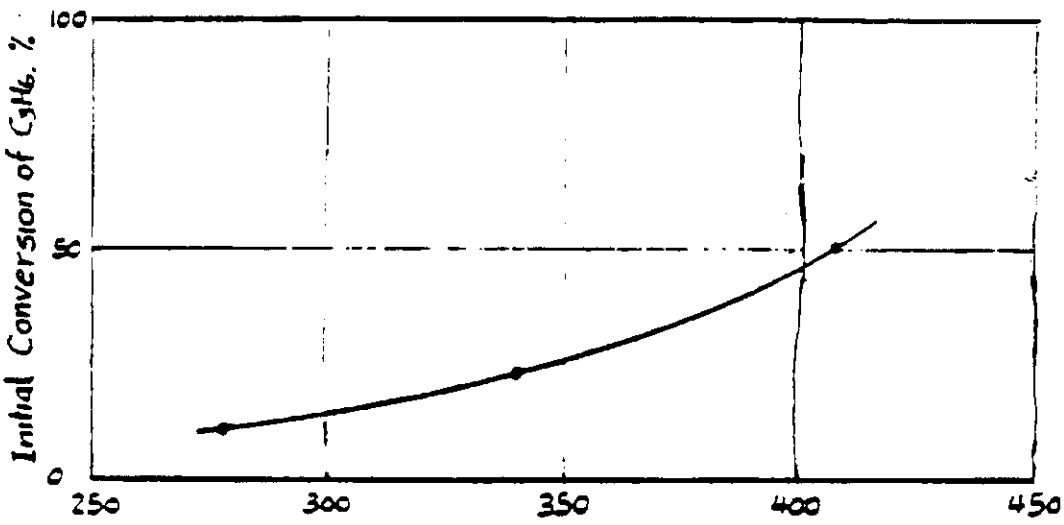


FIGURE 40

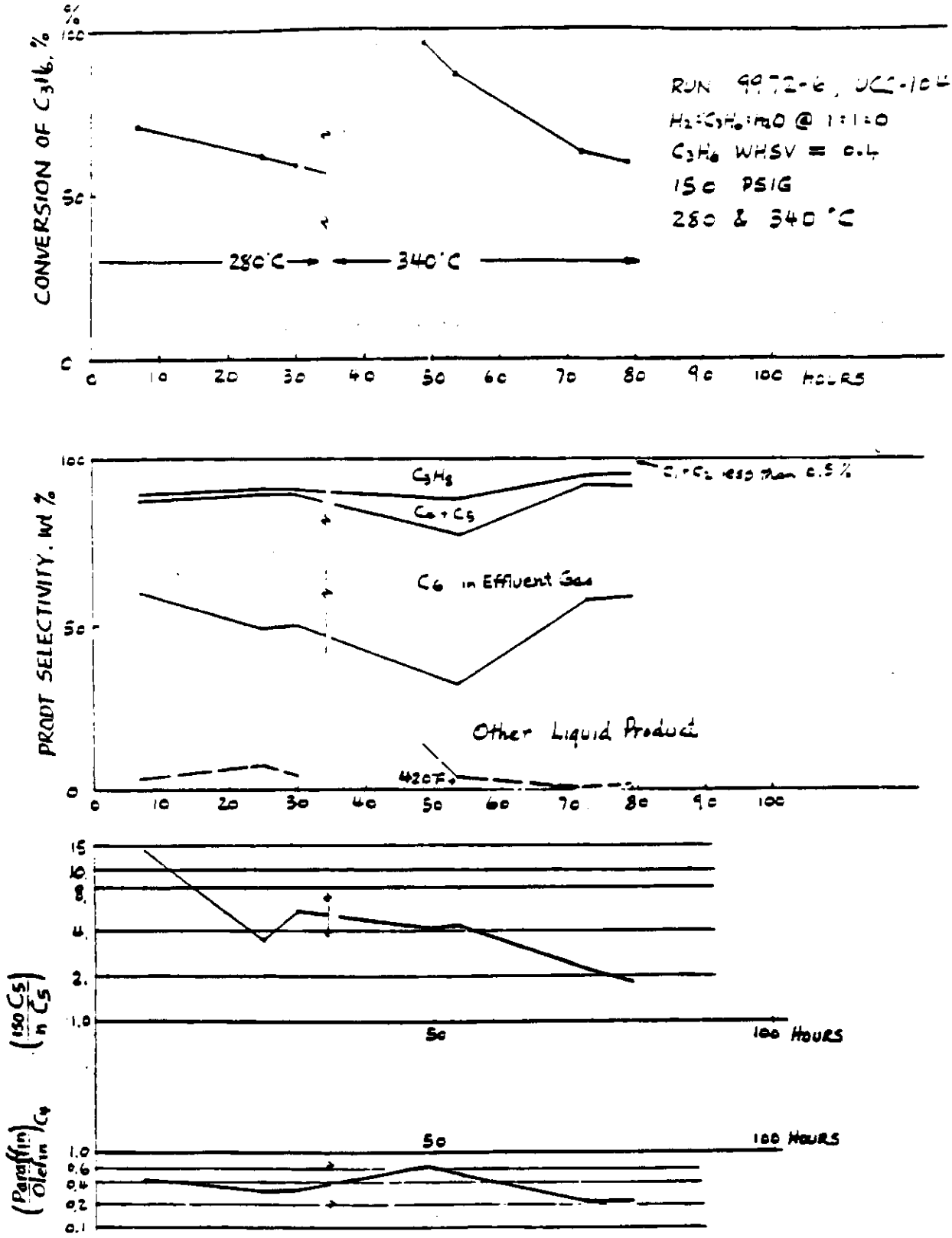

CONVERSION OF C_3H_6, %
%
100
50
0
0 10 20 30 40 50 60 70 80 90 100 HOURS
280°C
340°C
RUN 9972-6, UCC-10H
$H_2:C_3H_6:H_2O$ @ 1:1:0
C_3H_6 WHSV = 0.4
150 PSIG
280 & 340 °C
PRODT SELECTIVITY, Wt %
100
50
0
C_3H_8
C_4+C_5
C_1+C_2 less than 0.5 %
C_6 in Effluent Gas
Other Liquid Product
420°F+
0 10 20 30 40 50 60 70 80 90 100
$\left(\frac{iso\ C_5}{n\ C_5}\right)$
15
10
8
6
4
2
1.0
50
100 HOURS
$\left(\frac{Paraffin}{Olefin}\right)_{C_4}$
1.0
0.6
0.4
0.2
0.1
50
100 HOURS

FIGURE 42

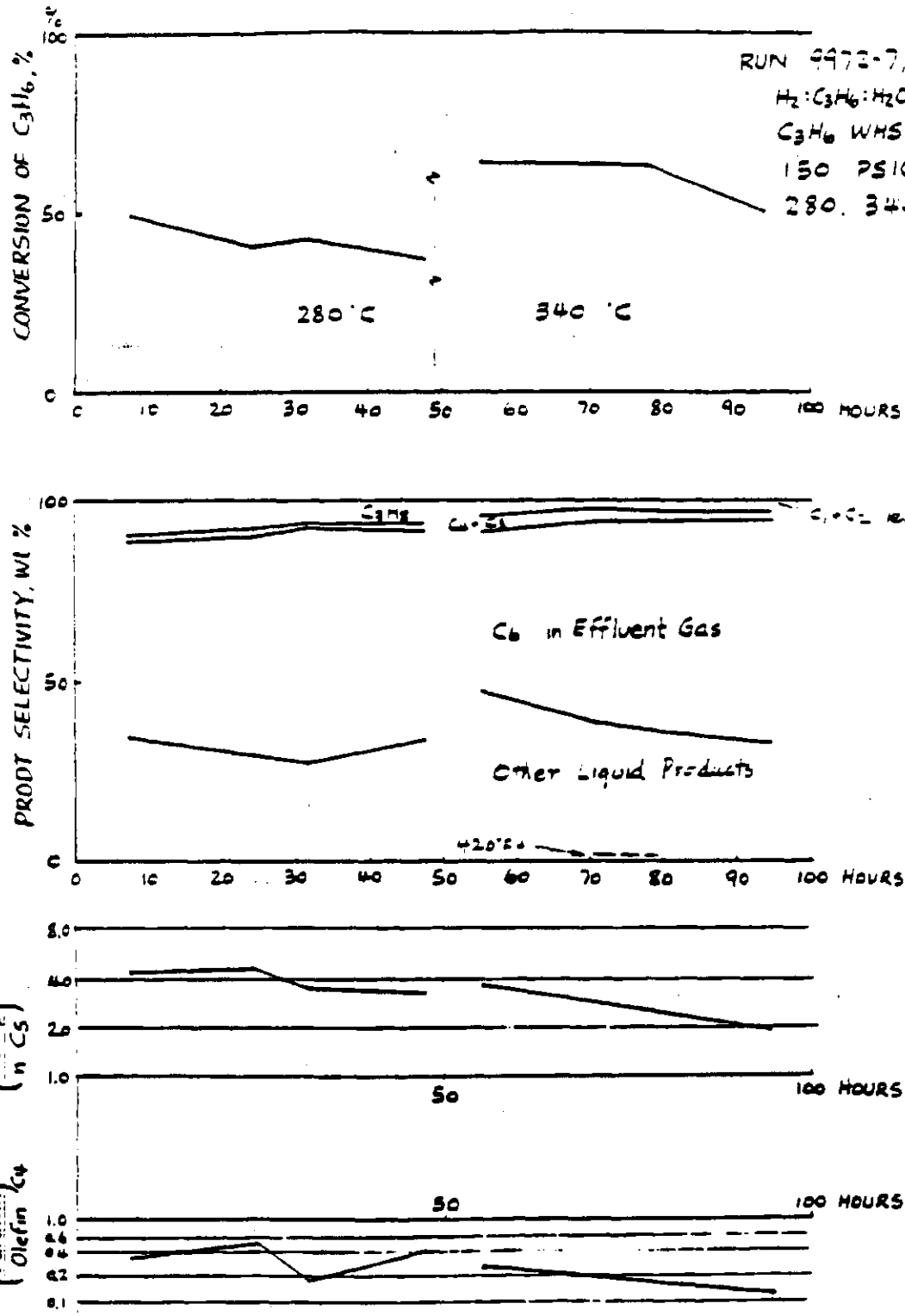
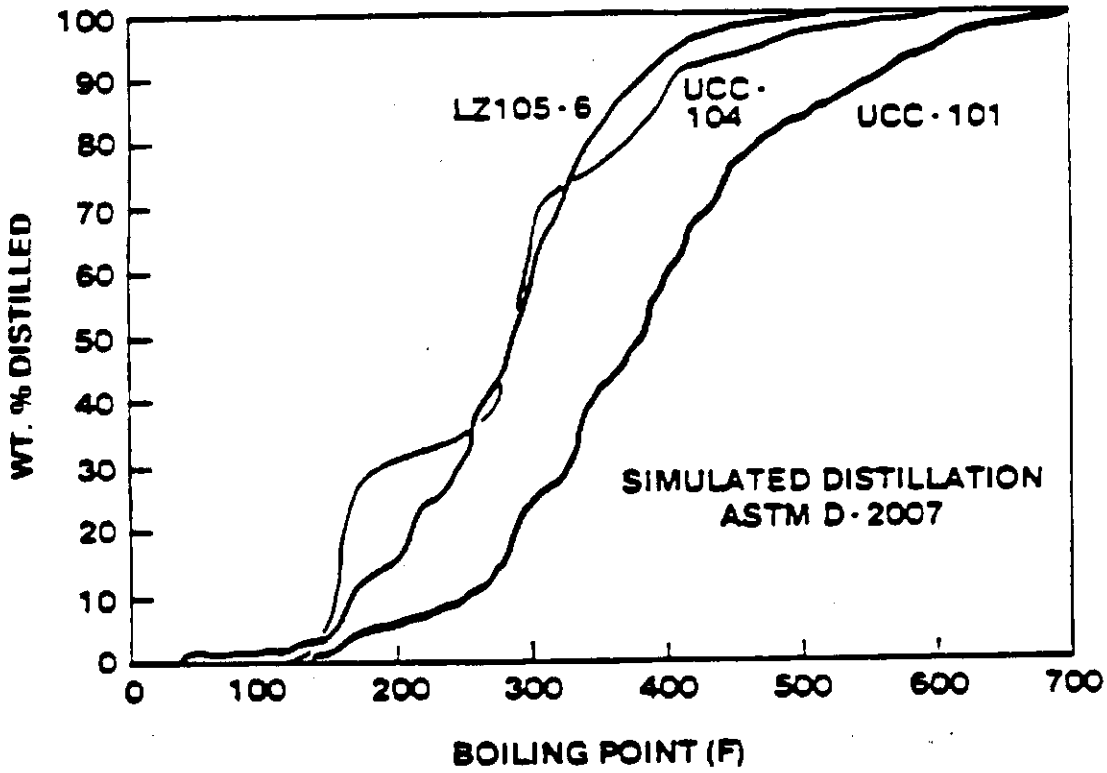

CONVERSION OF C_3H_6, %
RUN 9972-7, UCC-
$H_2:C_3H_6:H_2O$ @ 2:1:1
C_3H_6 WHSV = 0.5
150 PSIG
280, 340 °C
280 °C
340 °C
HOURS
PROD SELECTIVITY, WT %
C_3H_8
C_4-C_5
C_1+C_2 less than 0.2 %
C_6 in Effluent Gas
Other Liquid Products
420°F+
HOURS
$\left(\frac{iso\ C_5}{n\ C_5}\right)$
HOURS
$\left(\frac{Paraffin}{Olefin}\right)_{C_4}$
HOURS

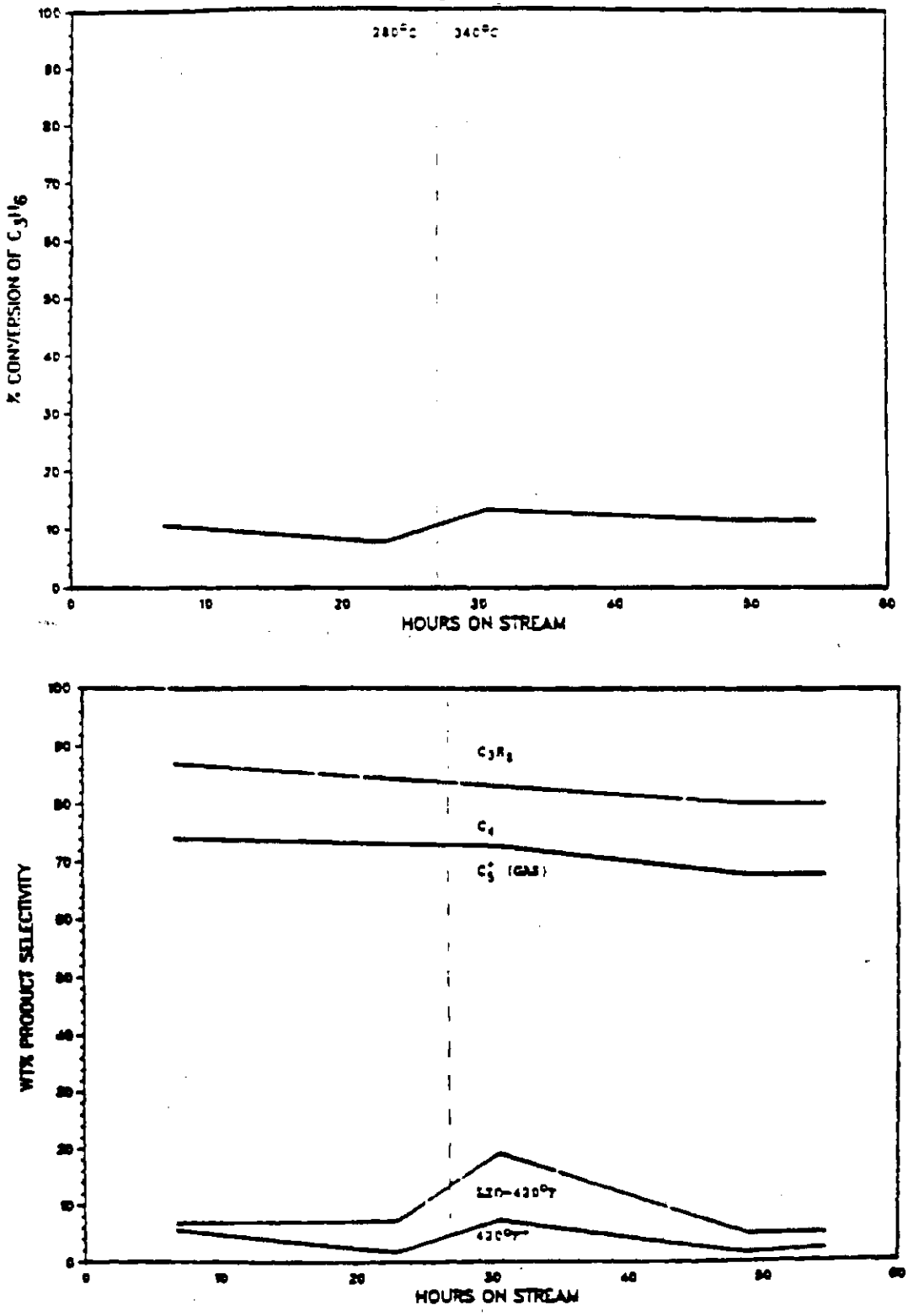
FIGURE 42

BOILING POINT DISTRIBUTION OF THE LIQUID PRODUCT OF PROPYLENE OLIGOMERIZATION USING LZ105-6, UCC 101, AND UCC 104 AS CATALYSTS.



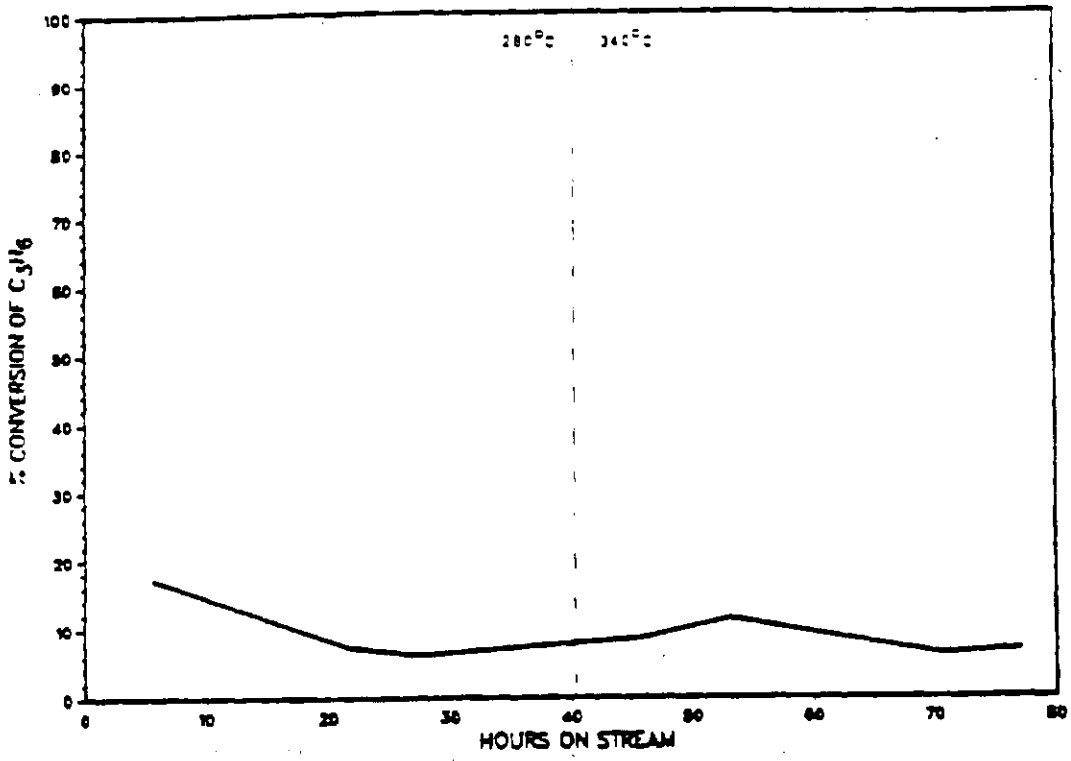
RUN NO. 9972-08

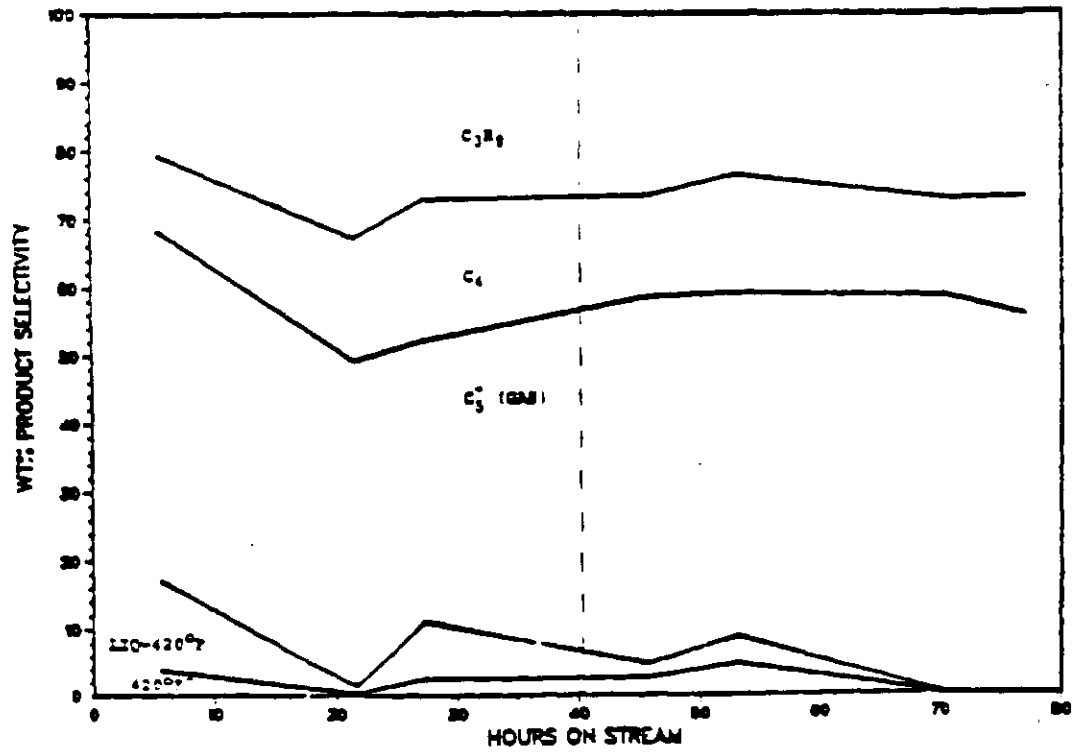
Fig. 43



RUN NO. 9972-09

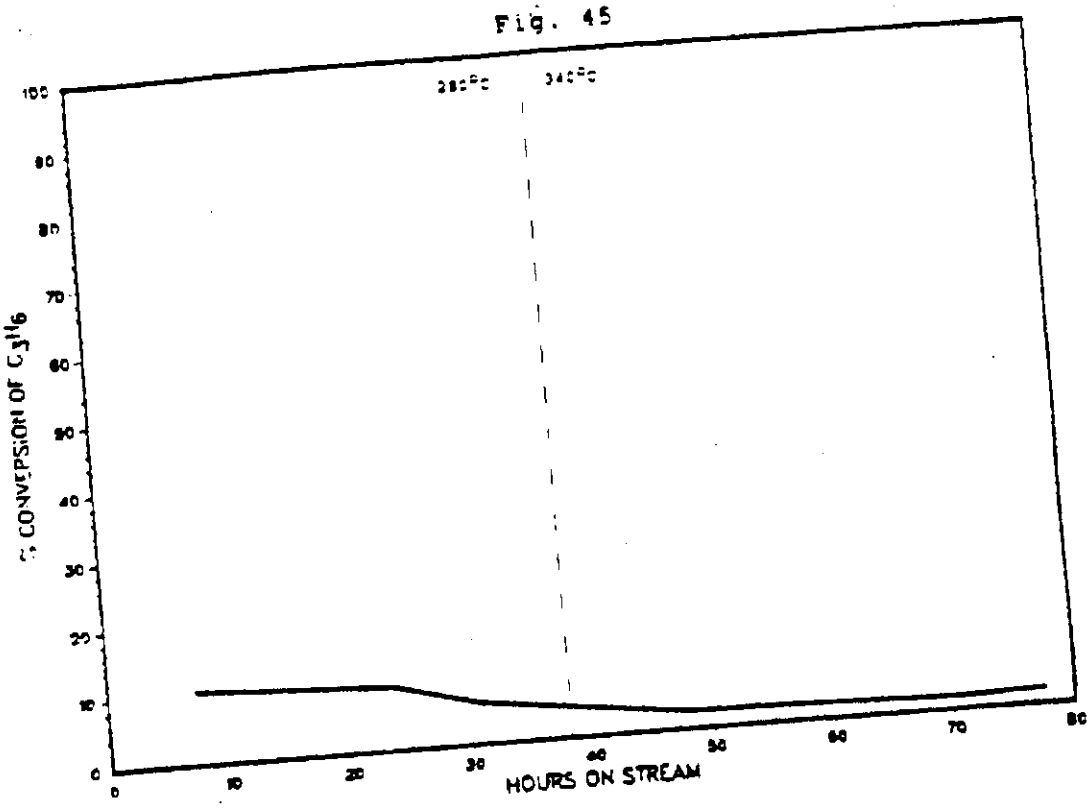
Fig. 44

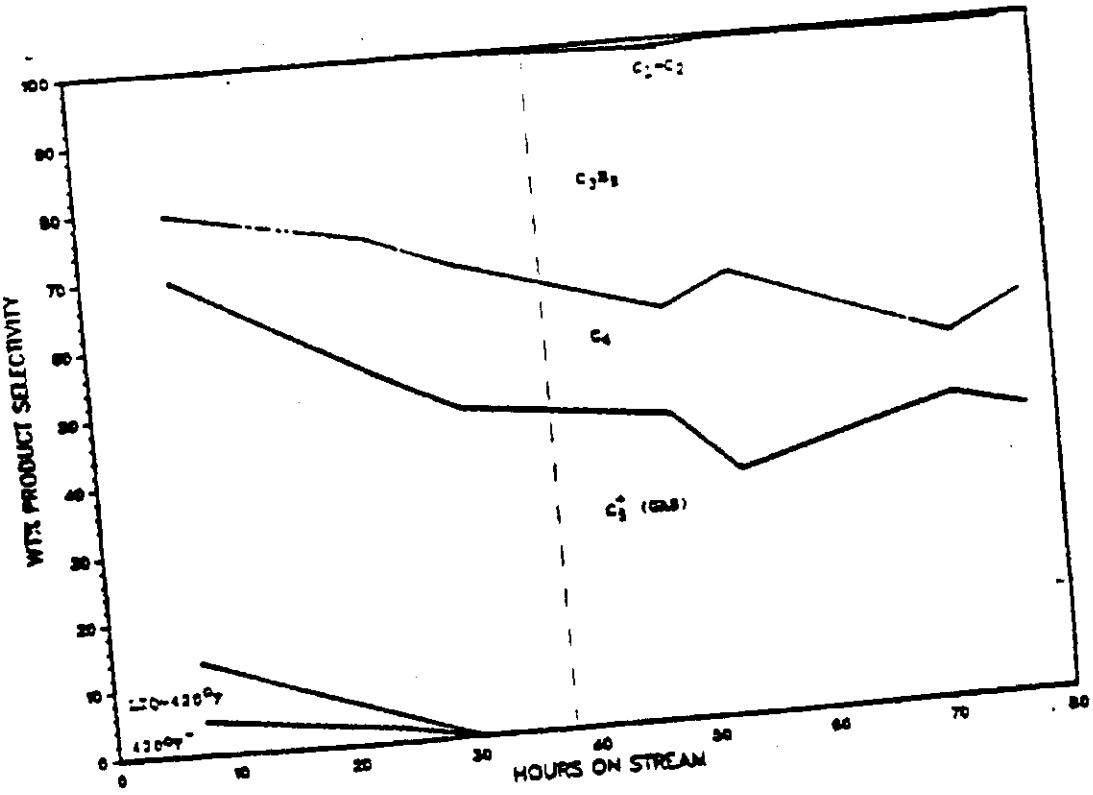




RUN NO. 9972-10

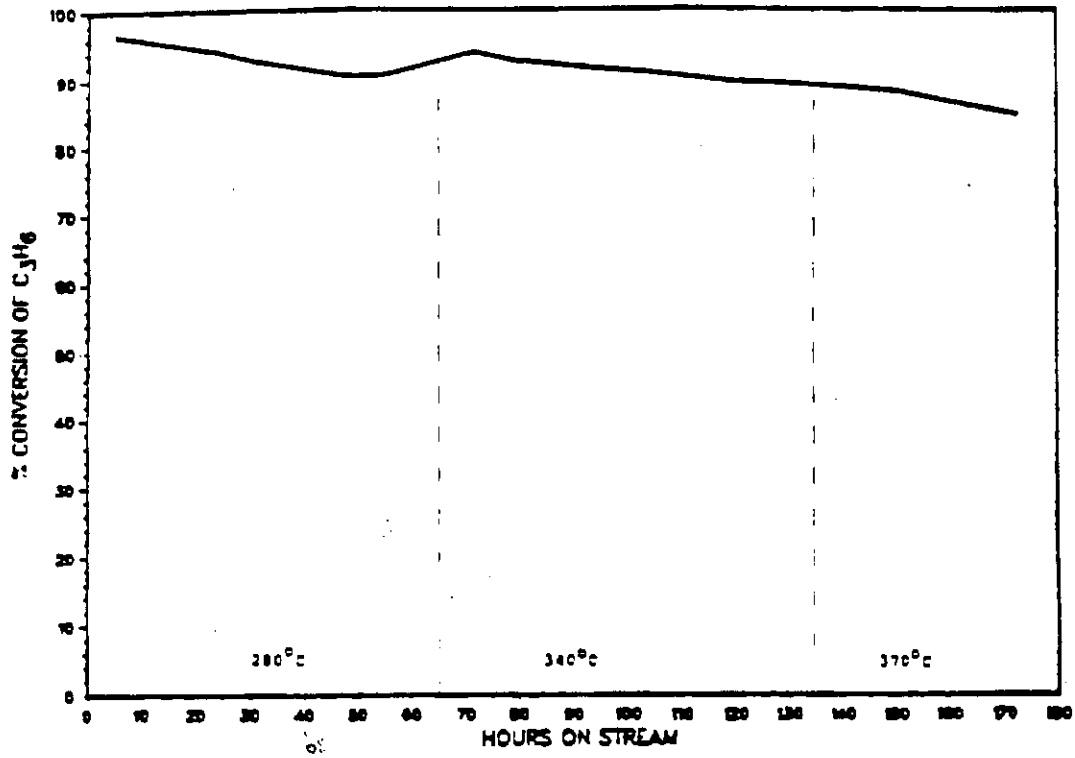
Fig. 45

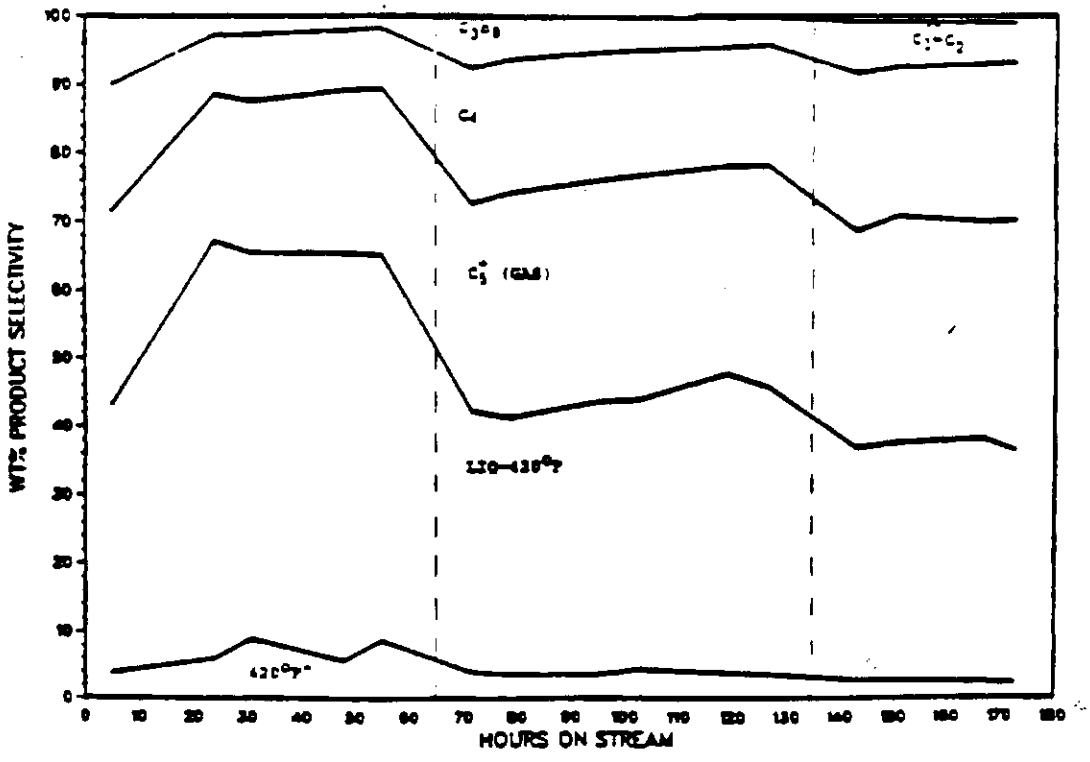




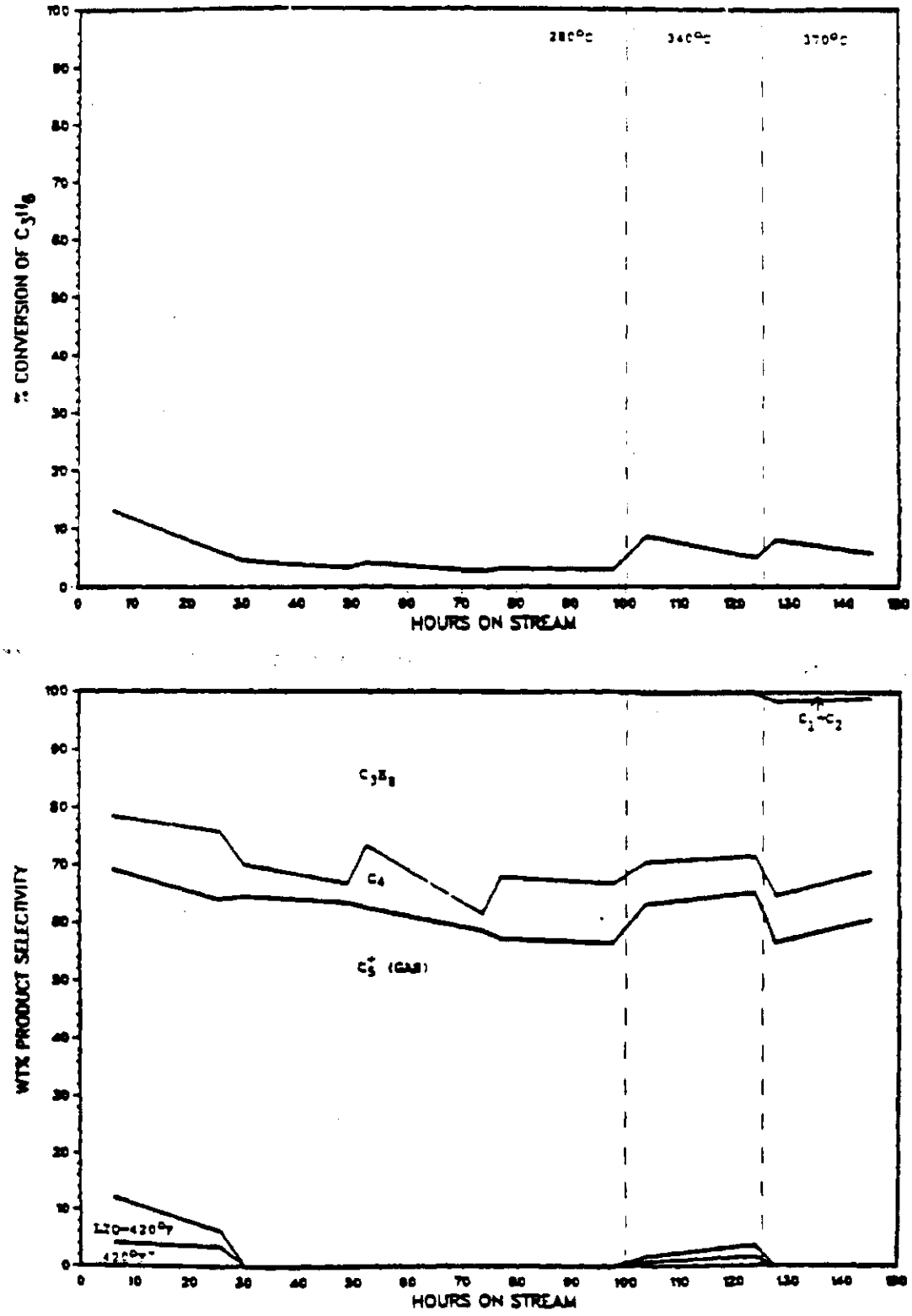
RUN NO. 9972-13

Fig. 46



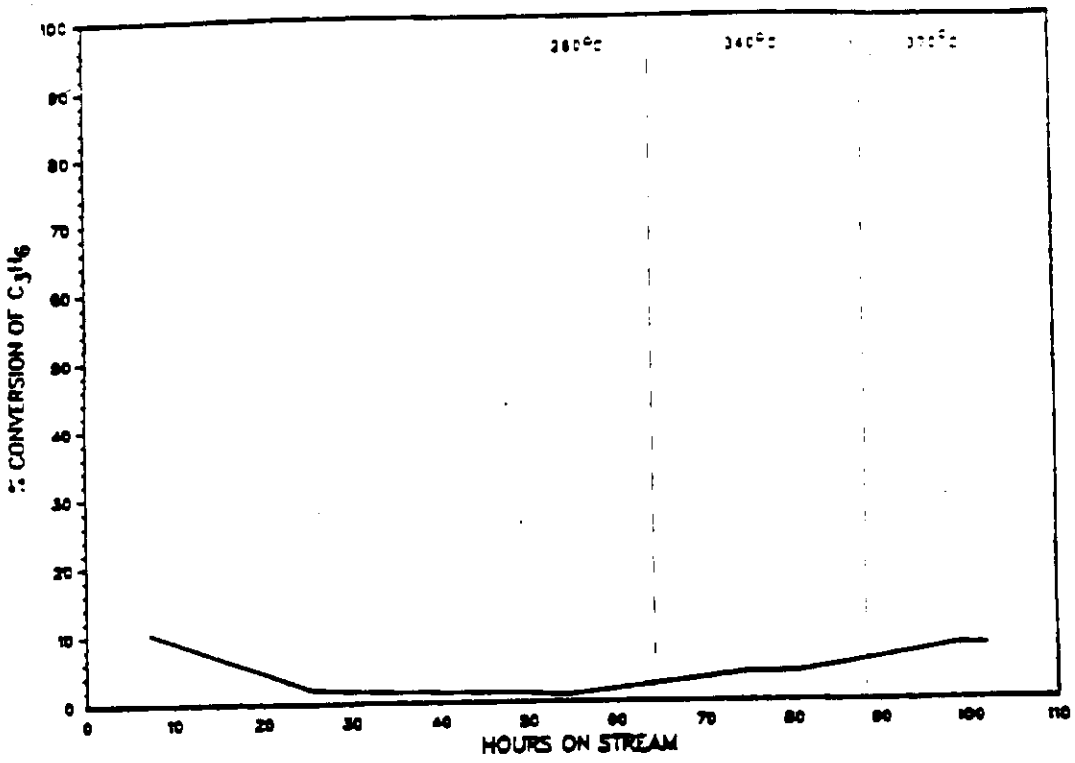


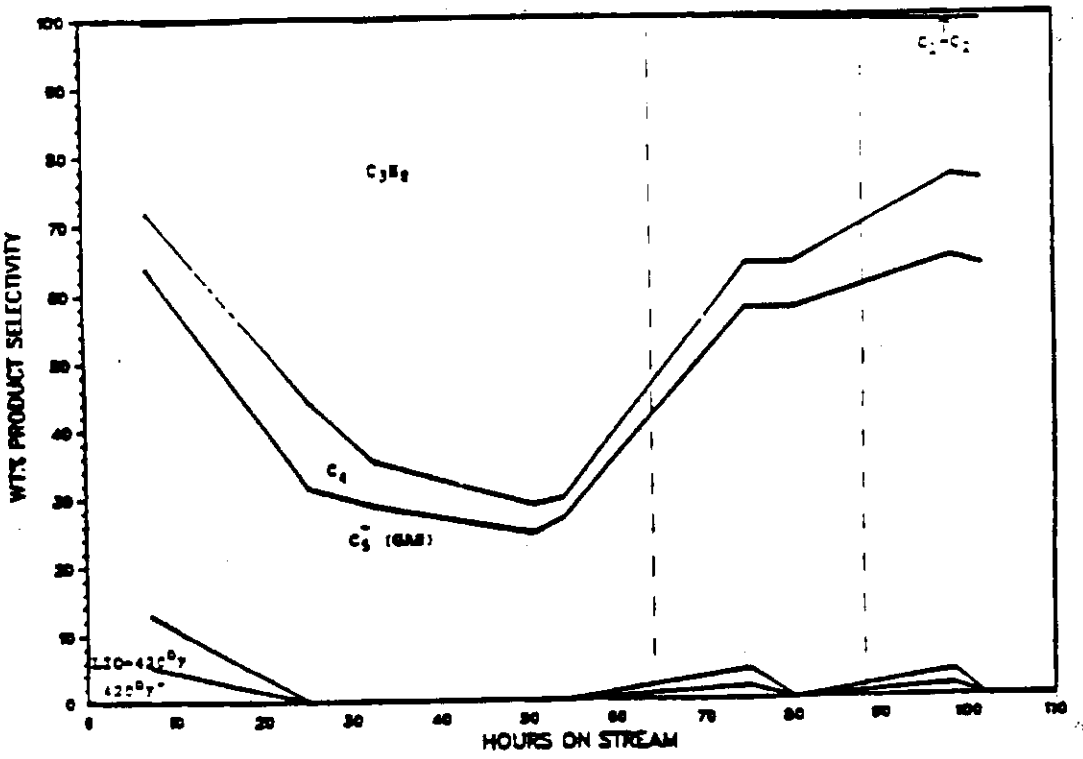
RUN NO. 9972-14
Fig. 47



RUN NO. 9972-15

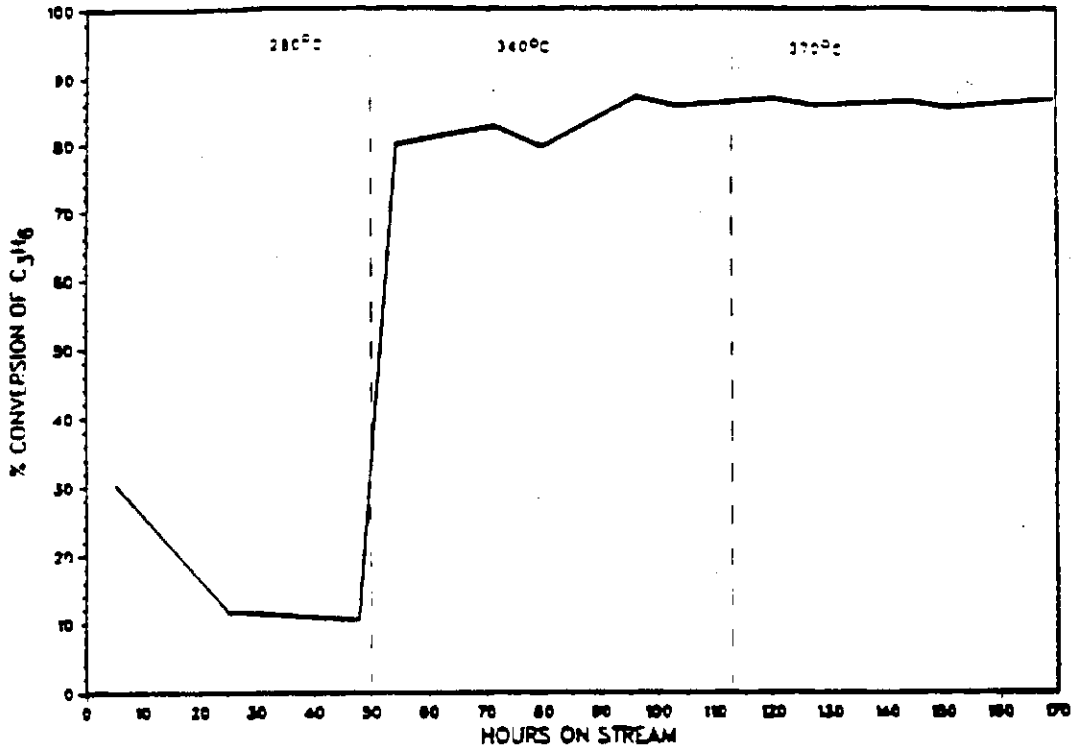
Fig. 48

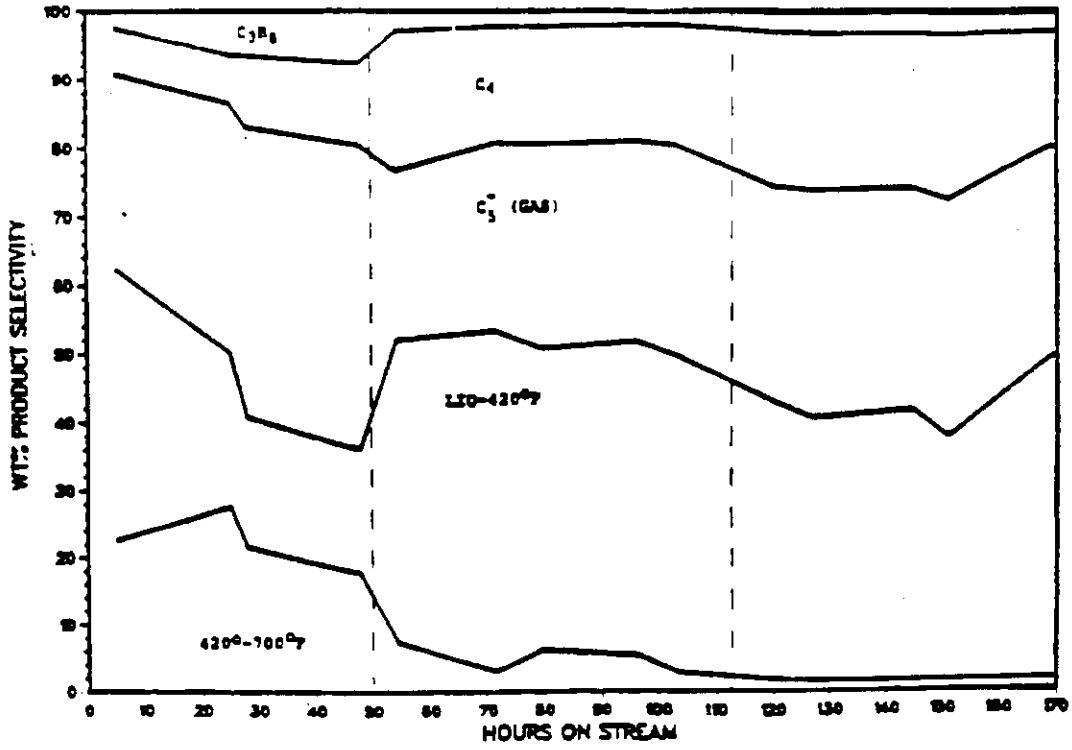




RUN NO. 9972-16

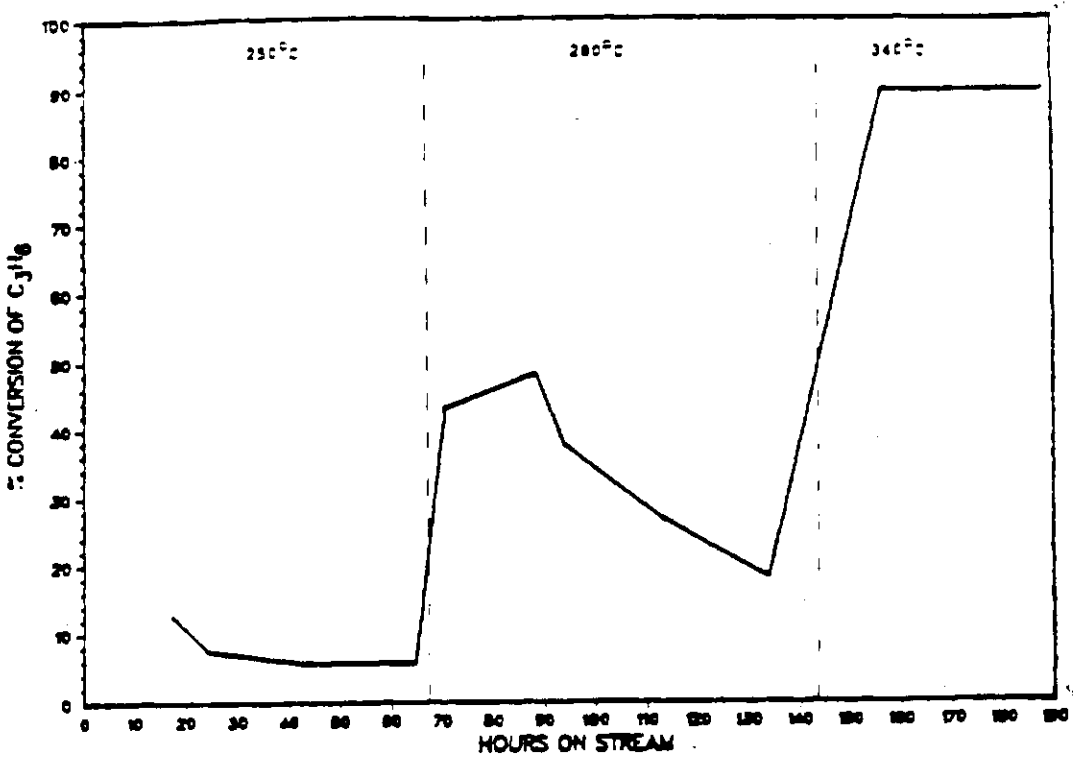
Fig. 49





RUN NO. 9972-17

Fig. 50



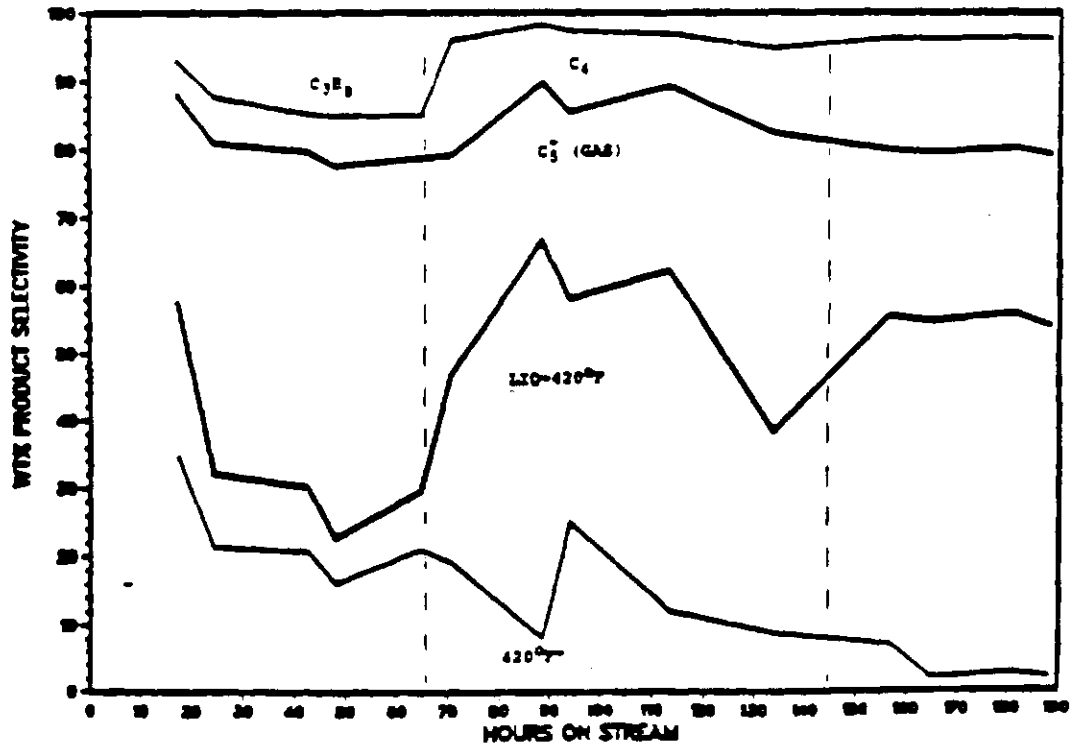
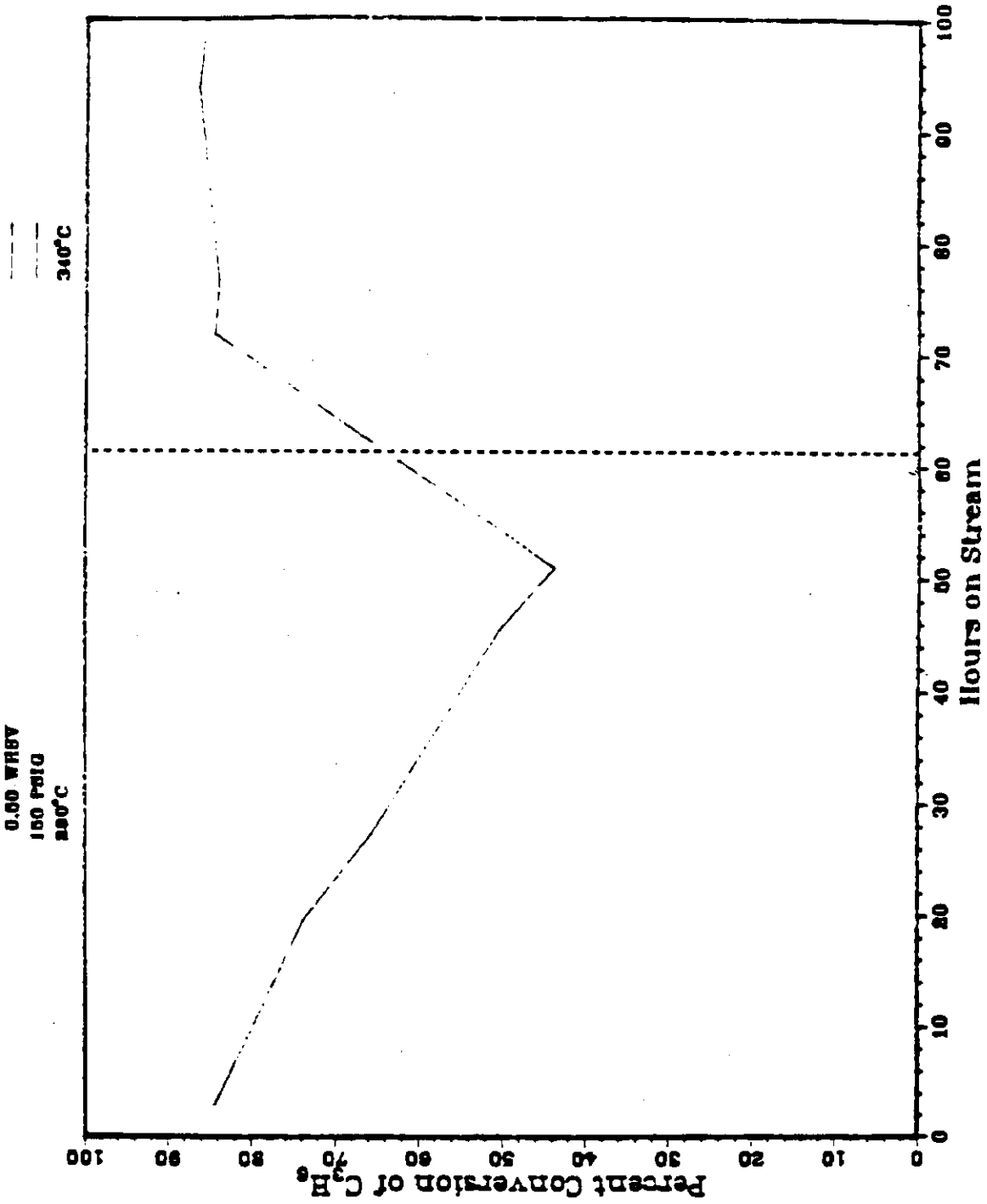


Fig. 51



997218

FIG. 52

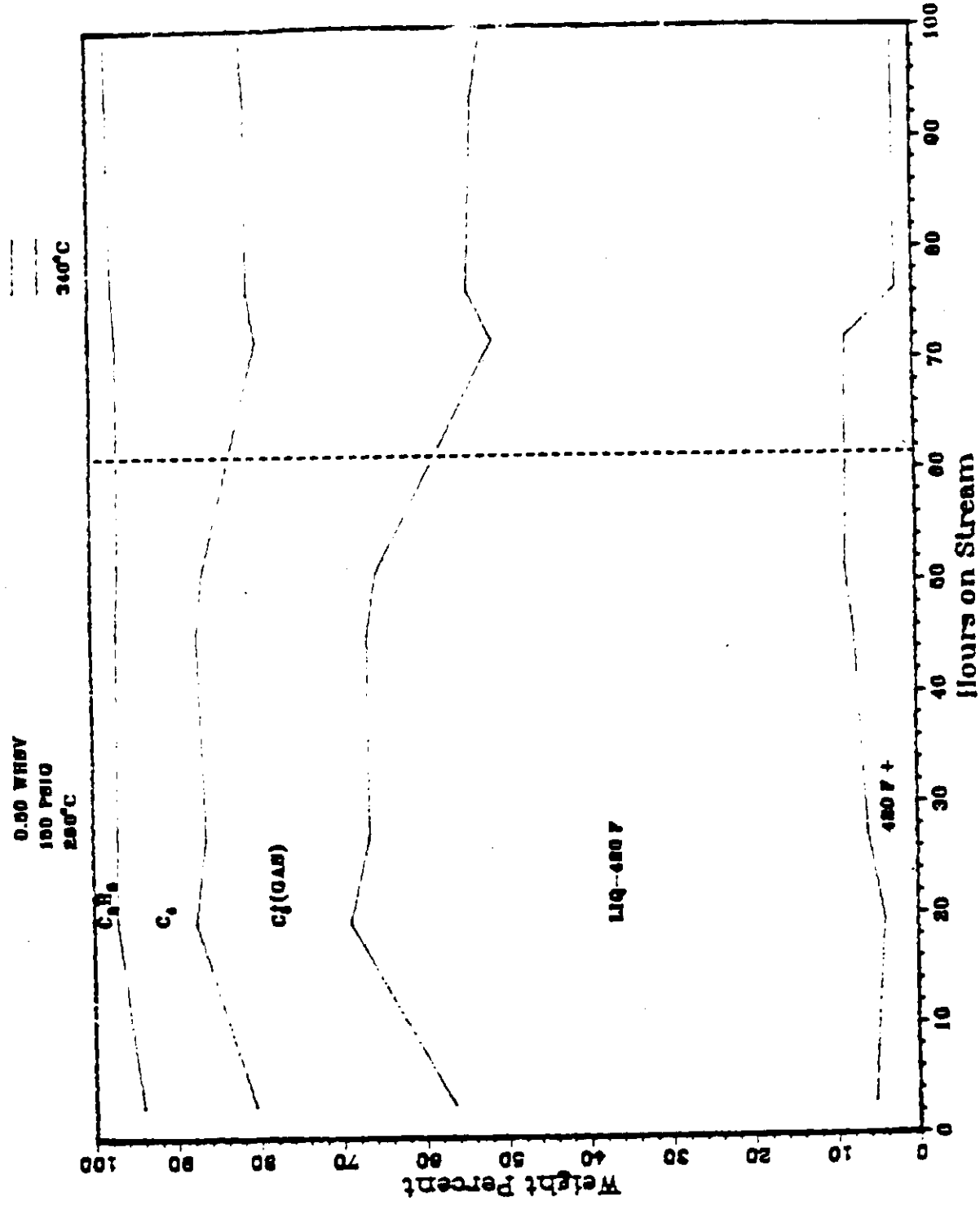
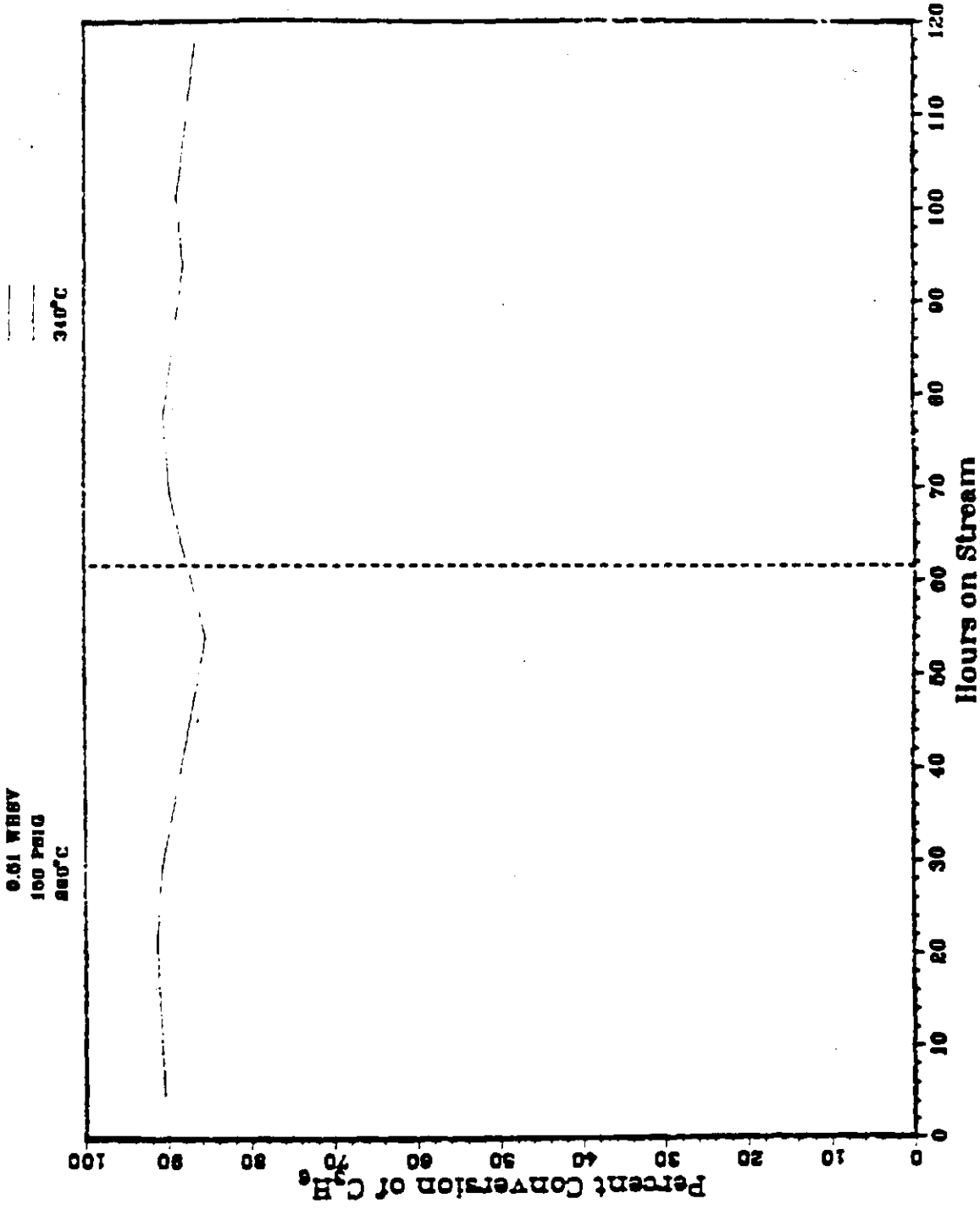
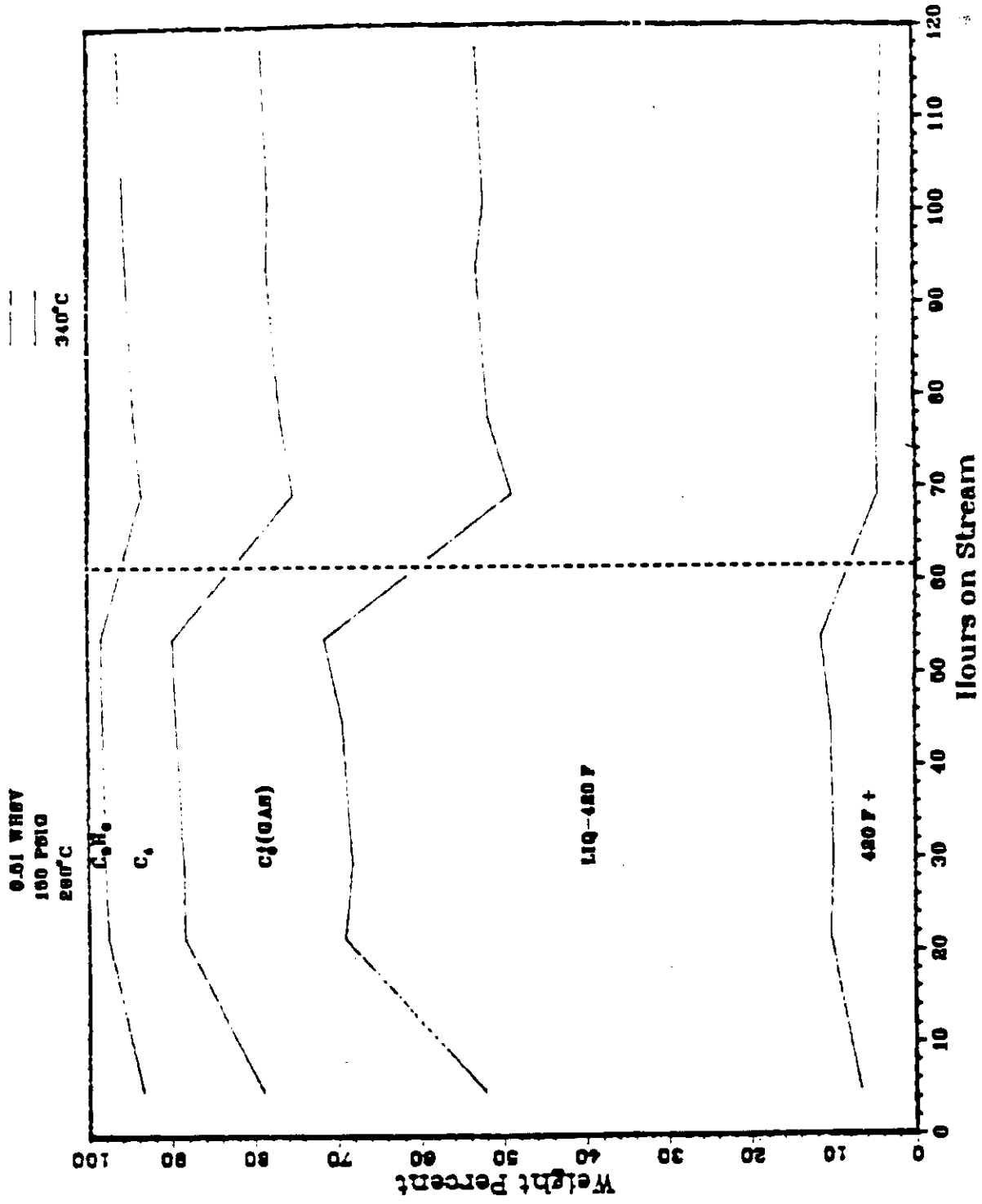

0.50 WHSV
100 PSIG
250°C
340°C
C_3H_8
C_6
C_7(BTX)
Liq-430 F
430 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100

Fig. 53


Percent Conversion of C_3H_8
Hours on Stream
0.01 WHSV
100 PSIG
360°C
340°C
0
10
20
30
40
50
60
70
80
90
100
110
120

99720

Fig. 54



997220

Fig. 55

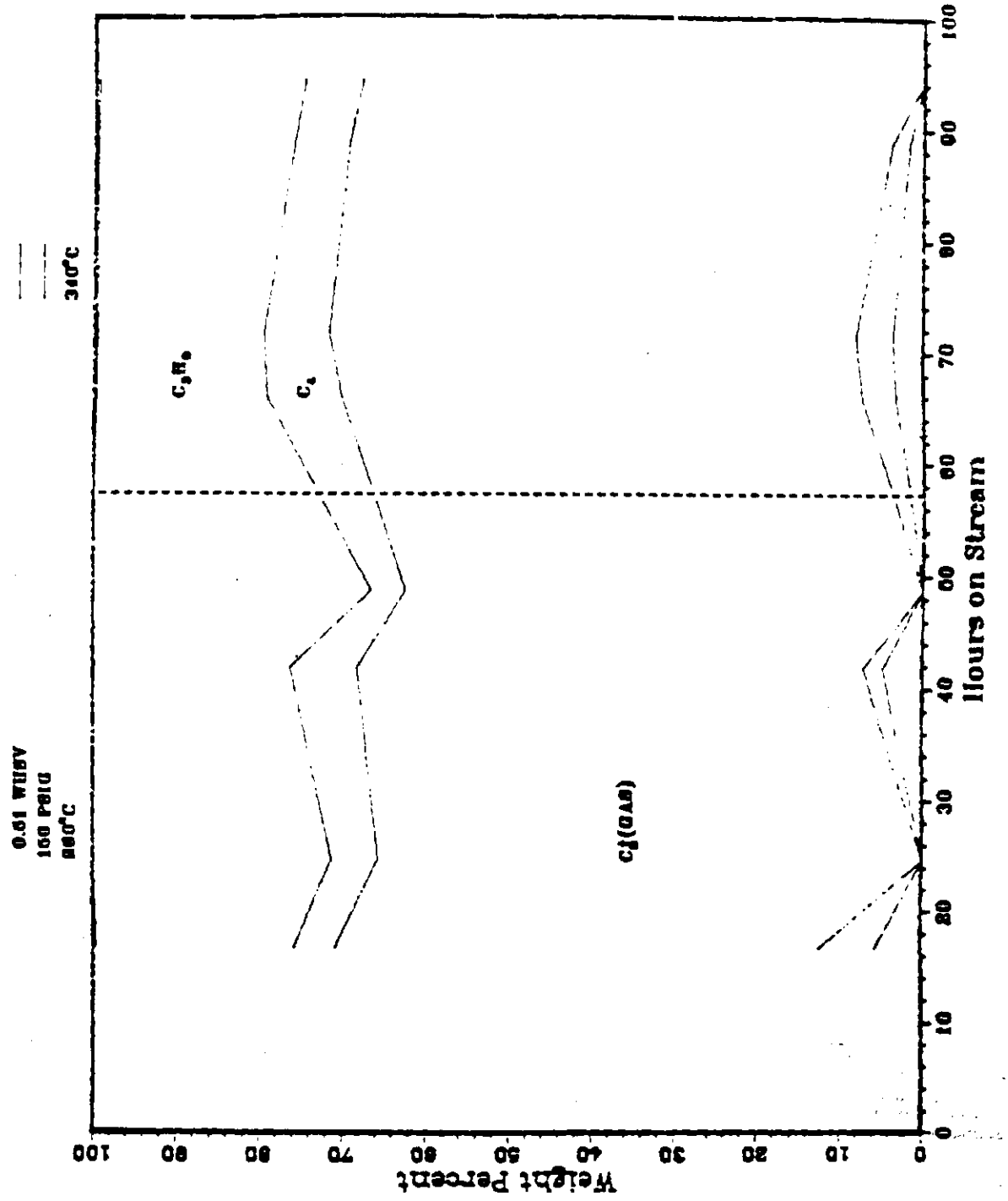

0.61 WHSV
150 PSIG
360°C
360°C
C_5H_8
C_4
C_1-(C_3)
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100

Fig. 56

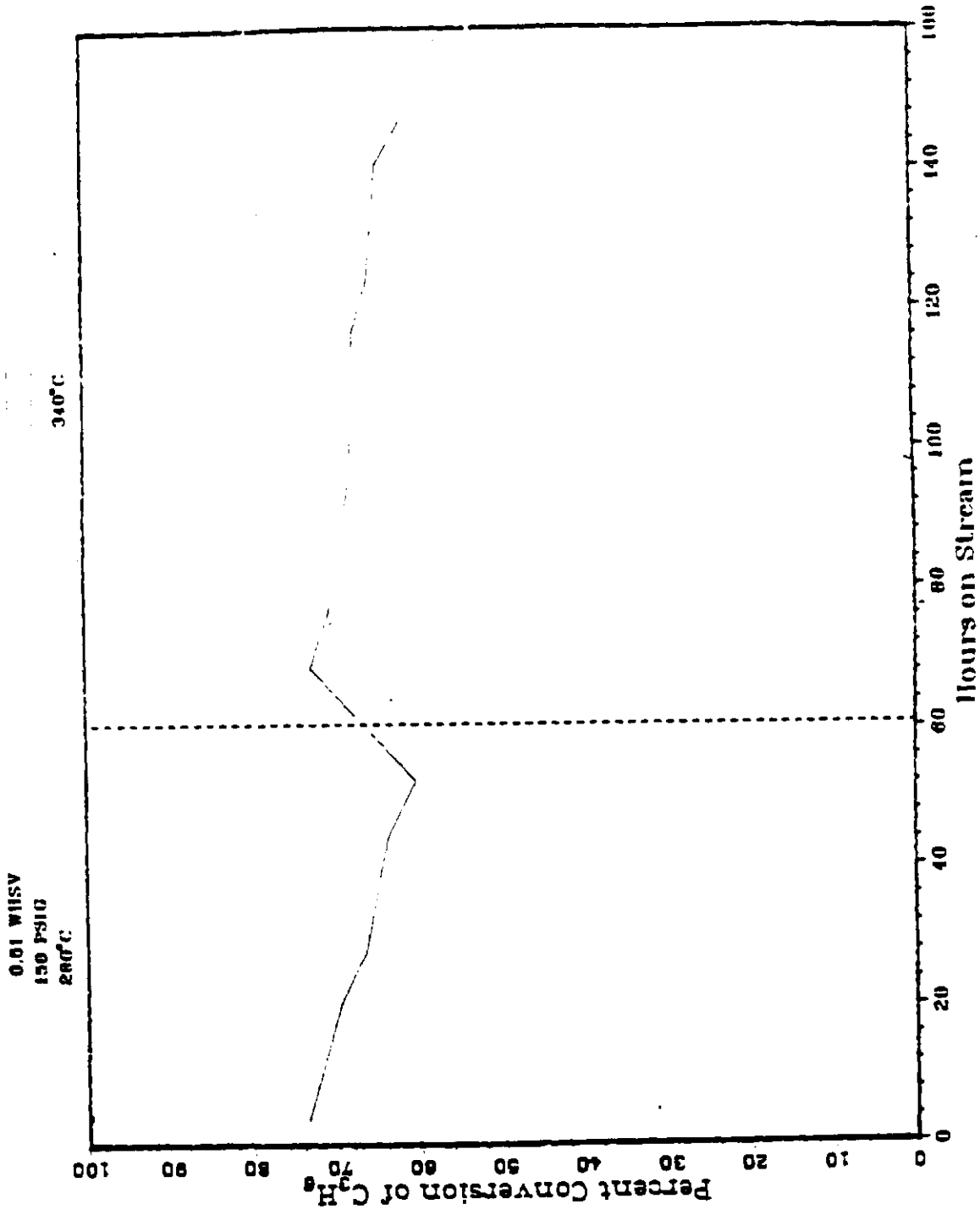
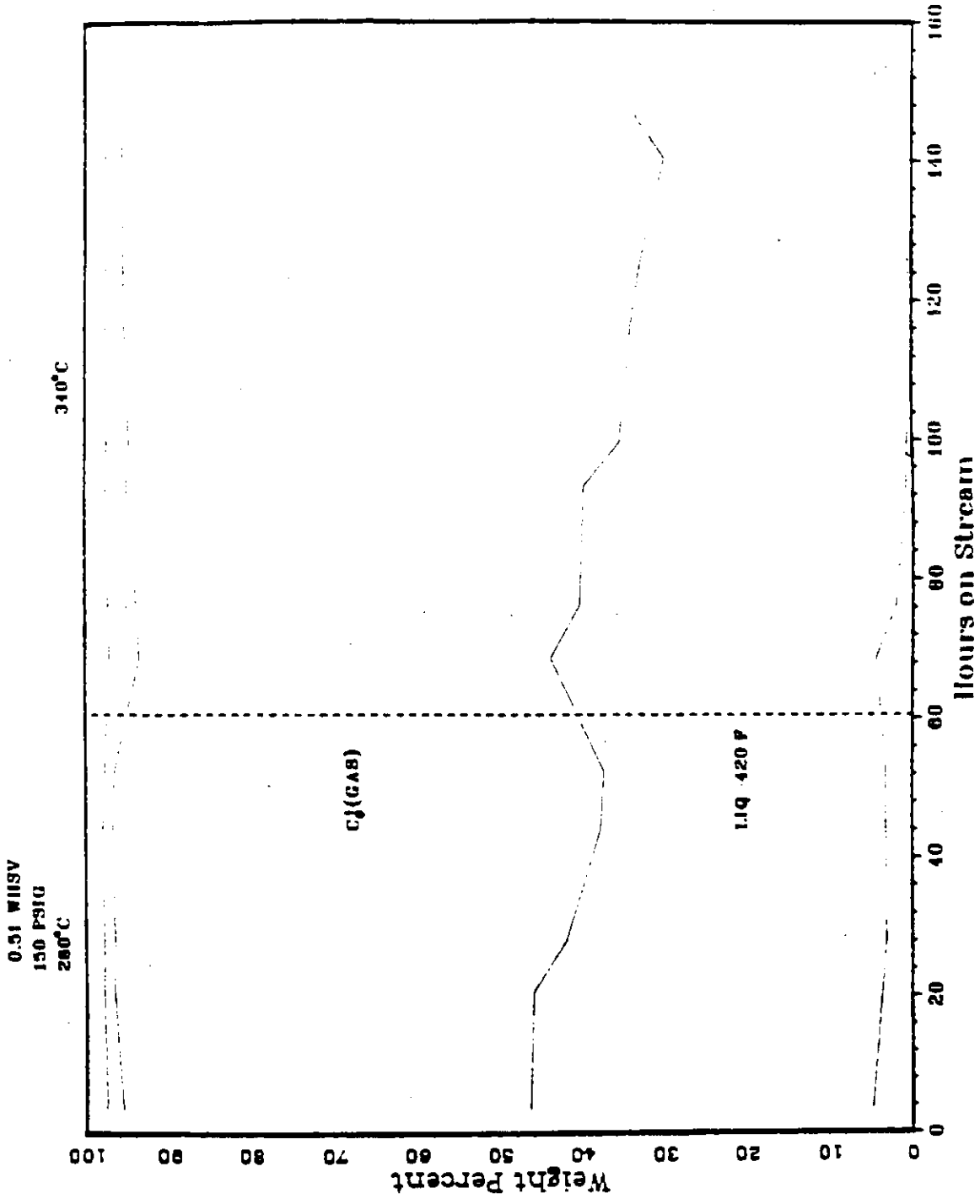
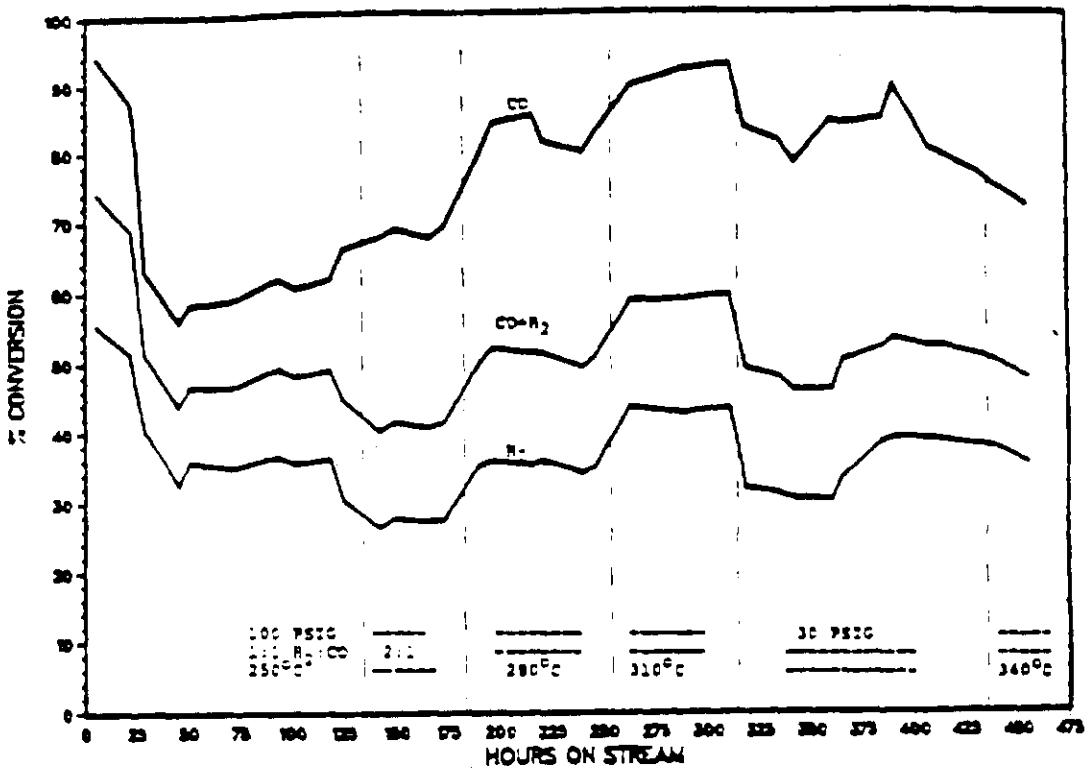

Percent Conversion of C_3H_8
Hours on Stream
0.01 WHSV
150 PSIG
280°C
340°C
0
10
20
30
40
50
60
70
80
90
100
120
140
160

Fig. 57


0.51 WHSV
150 PSIG
280°C
340°C
C4(GAS)
LIQ 420 F
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160

RUN NO. 10011-06
Fig. 58



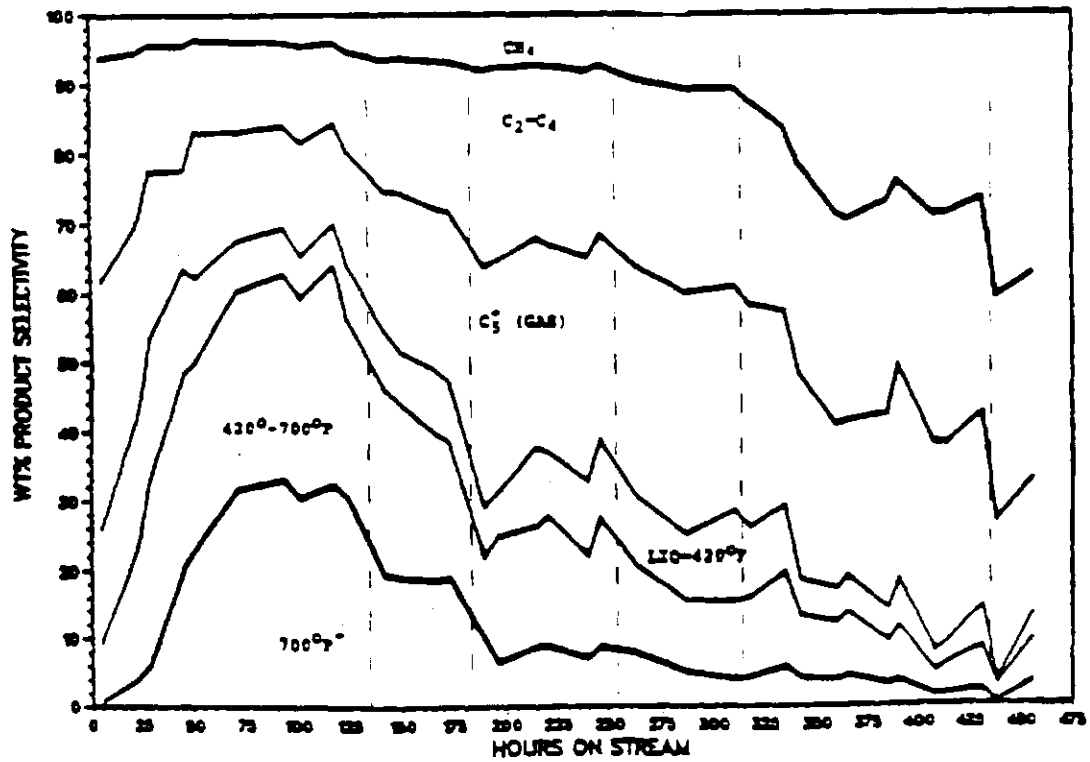
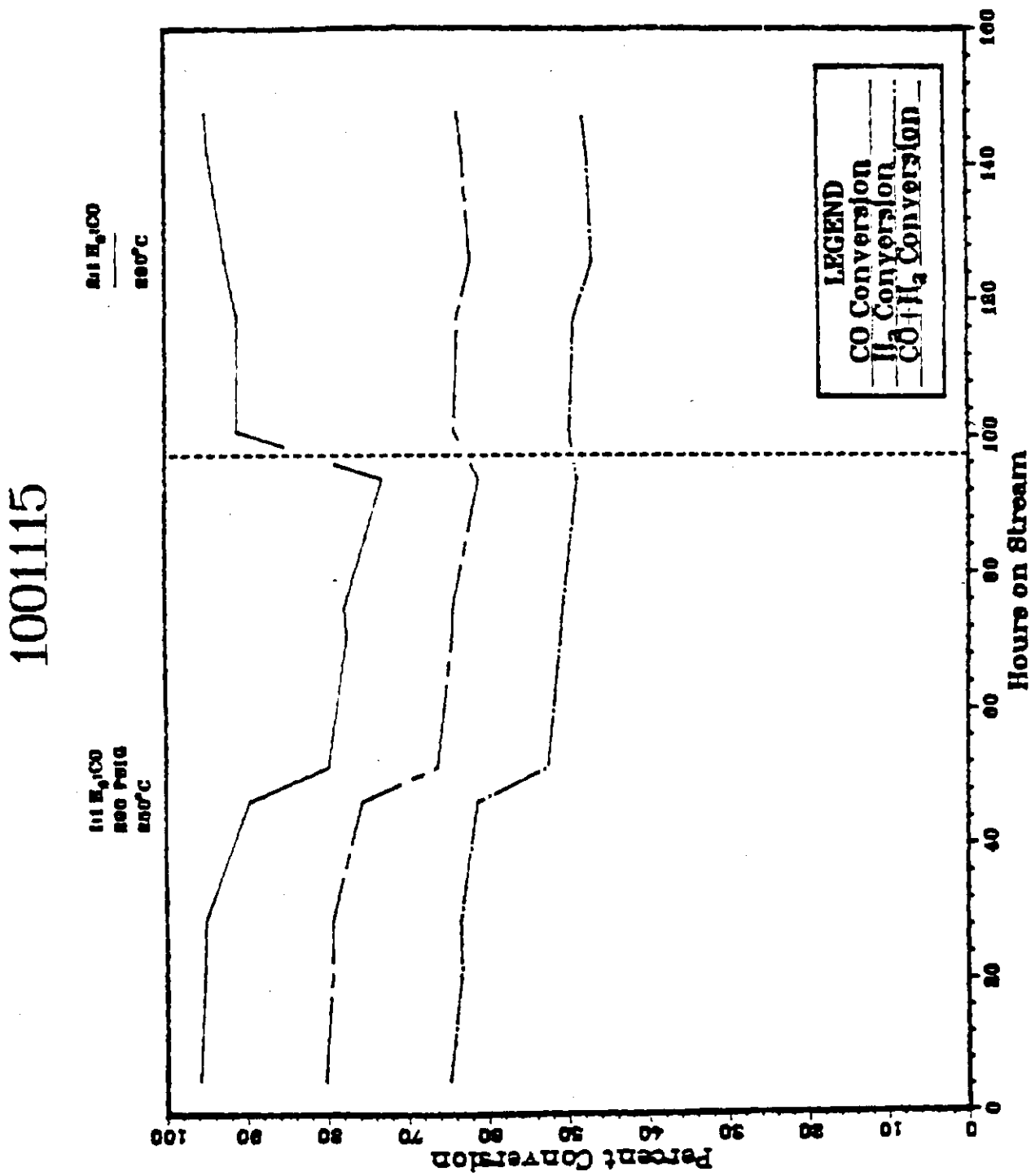
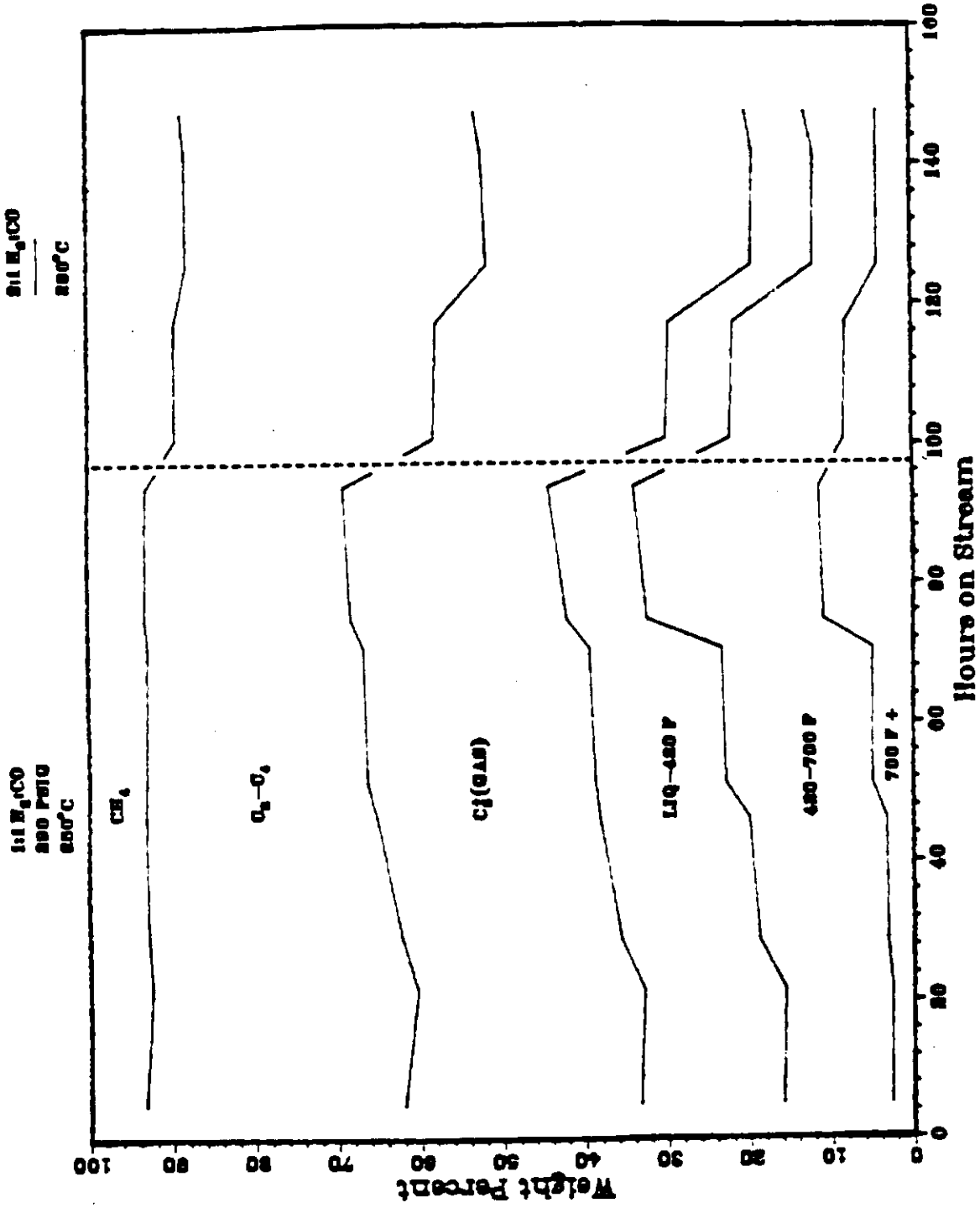


Fig. 59



1001115

Fig. 60



1001115

RUN NO. 10011–07

Fig. 61

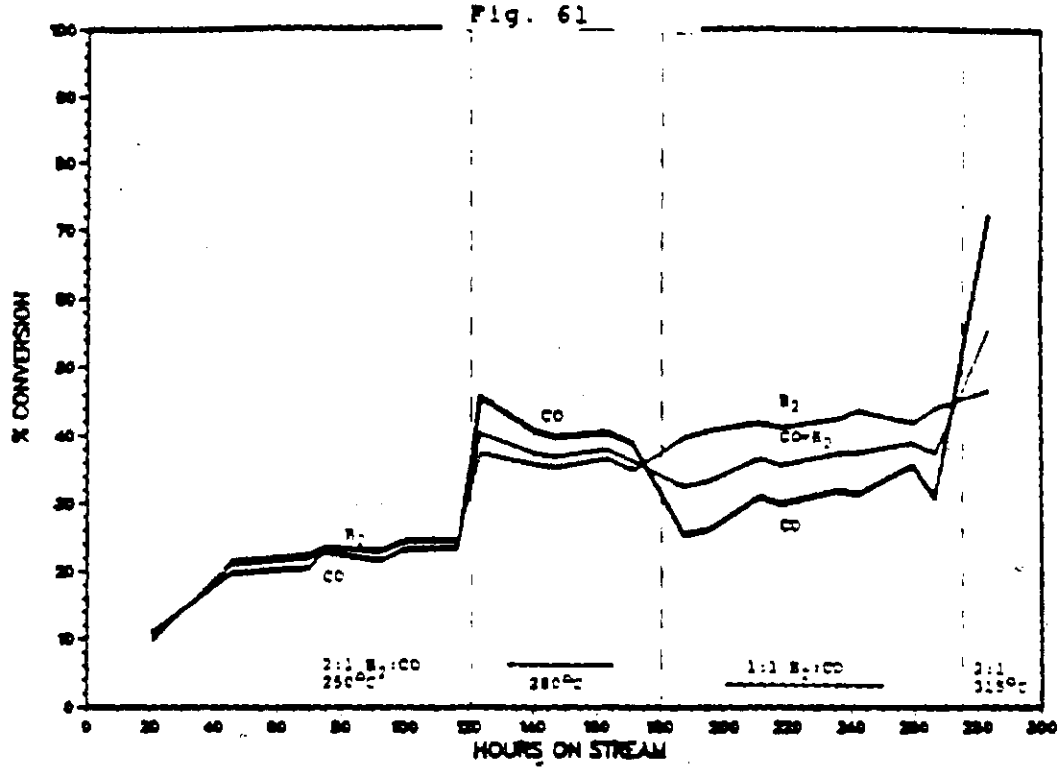
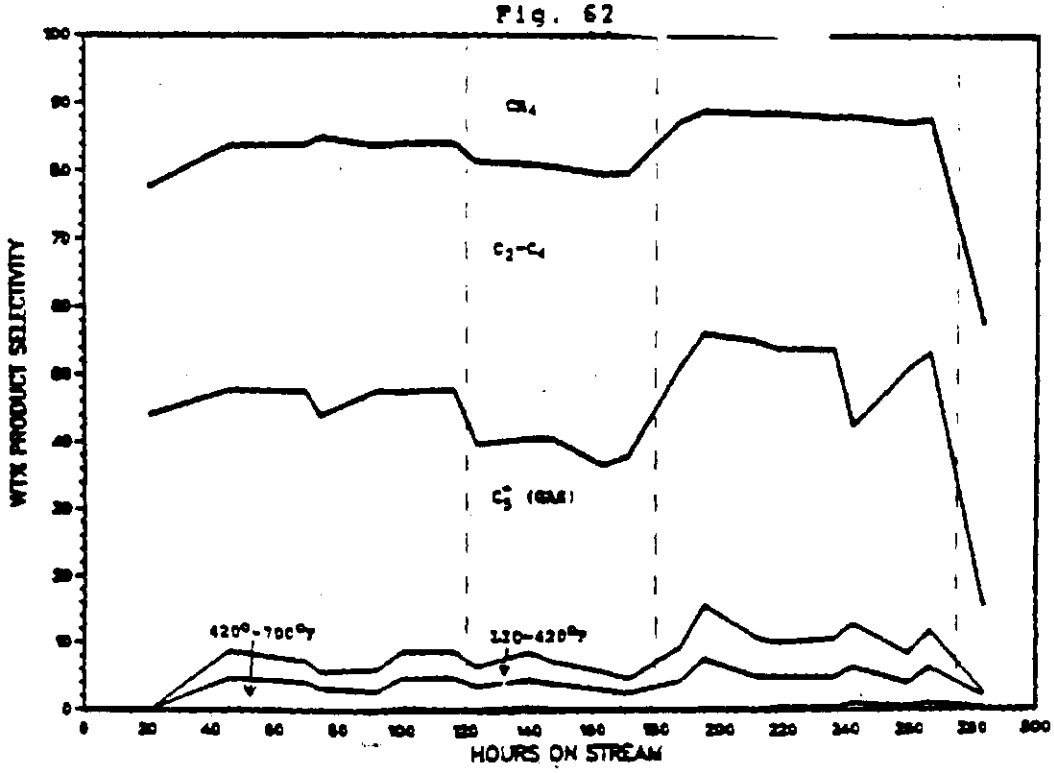


Fig. 62



RUN NO. 1001I—02

Fig. 63

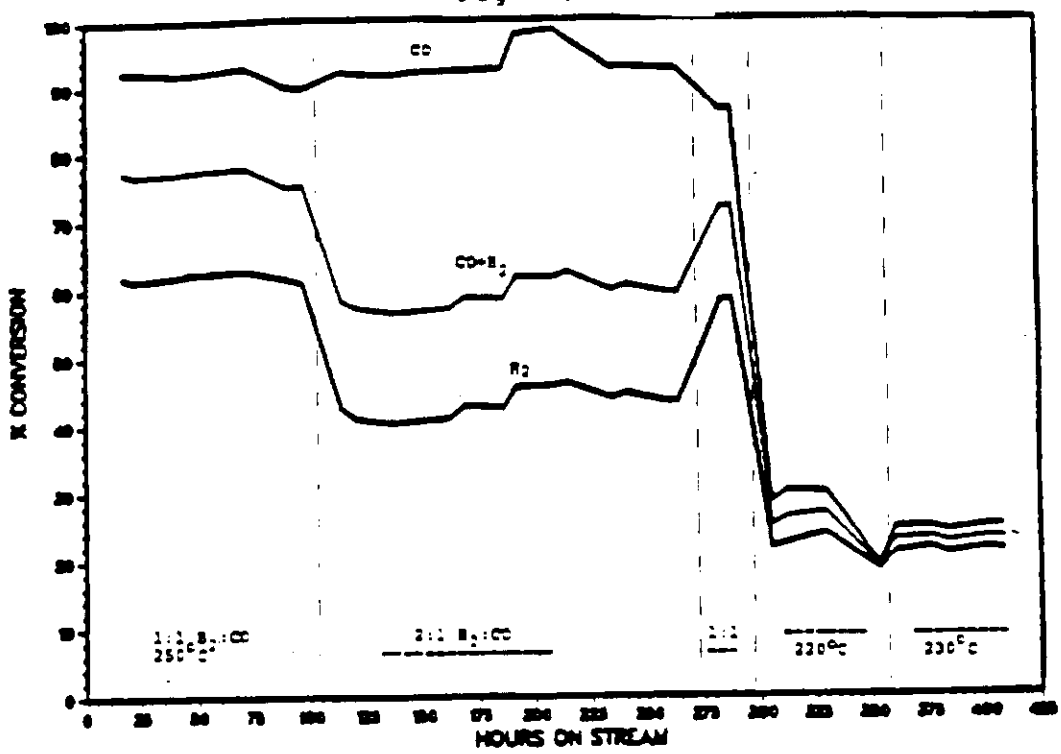


Fig. 64

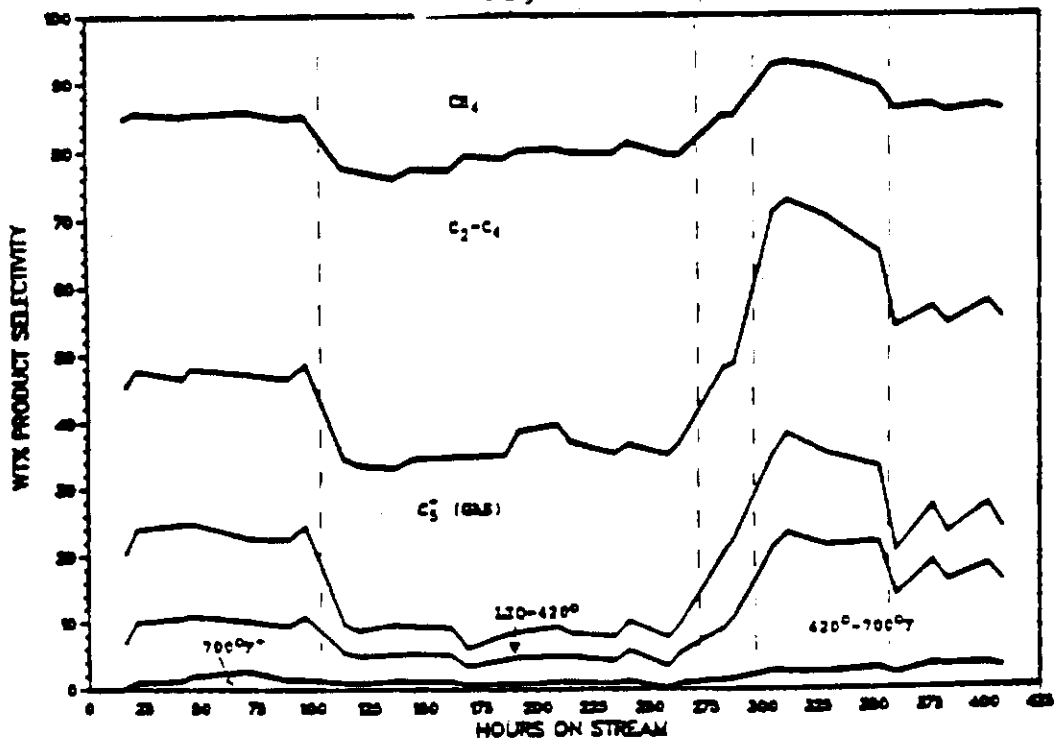
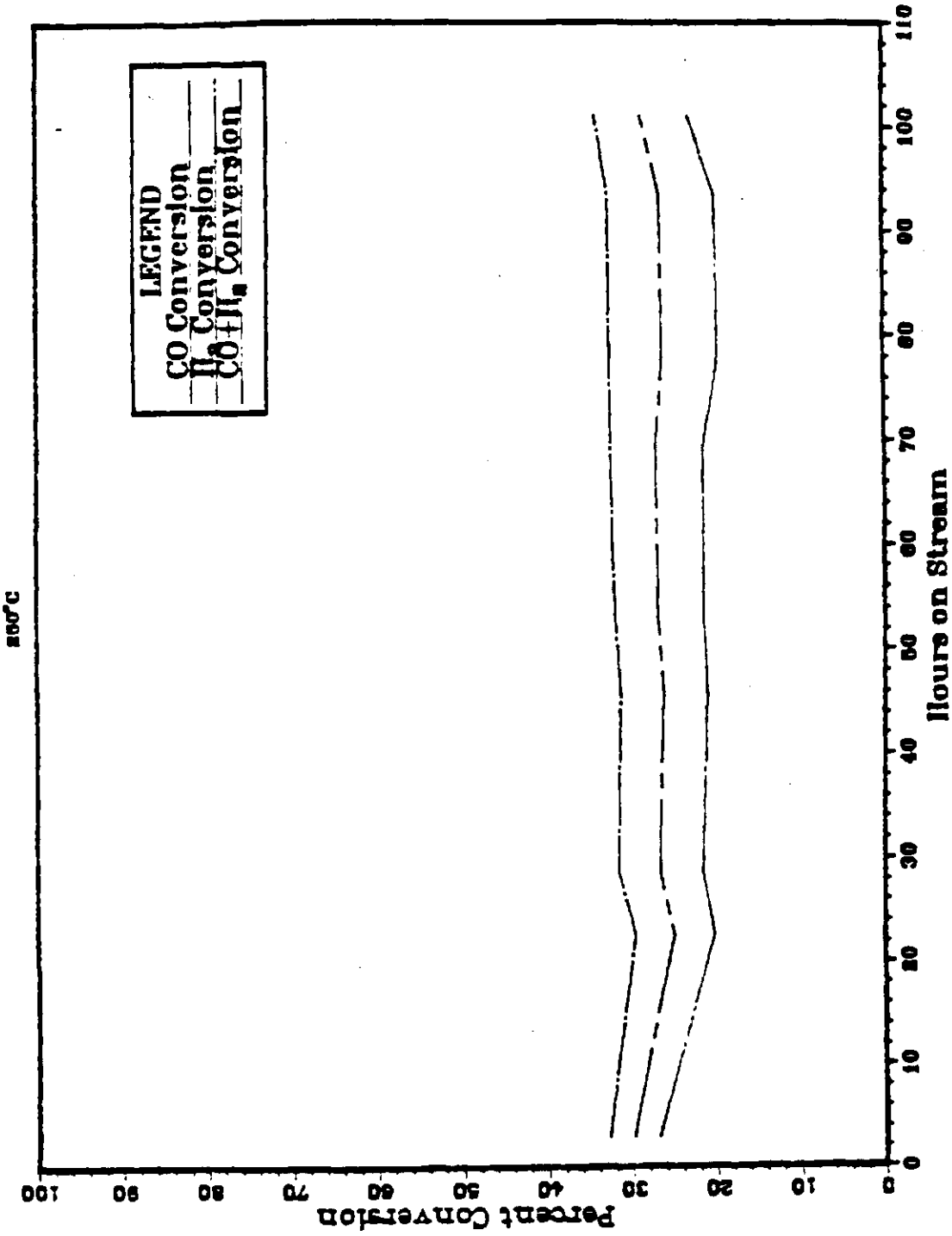


Fig. 65



1001111

Fig. 66

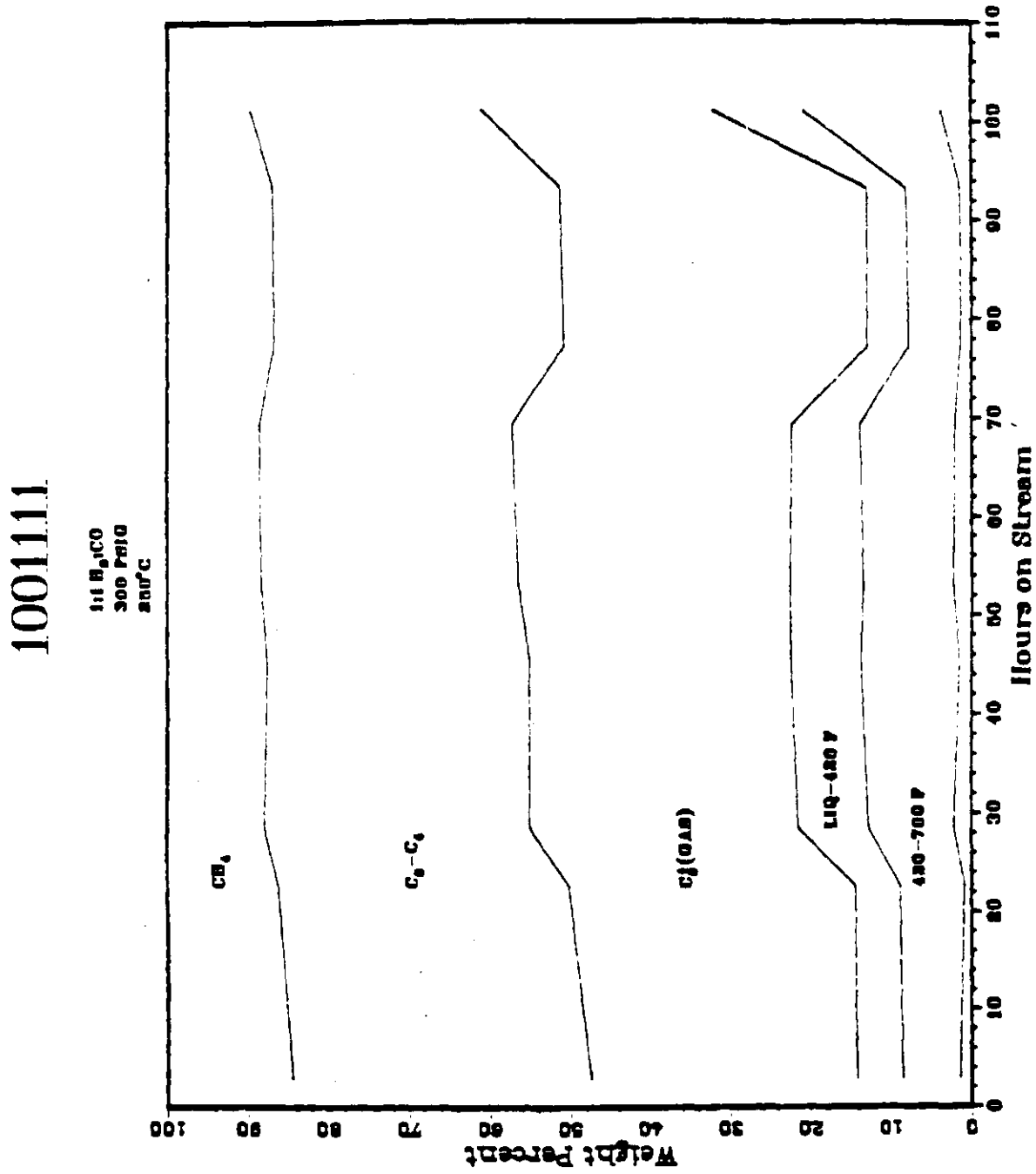
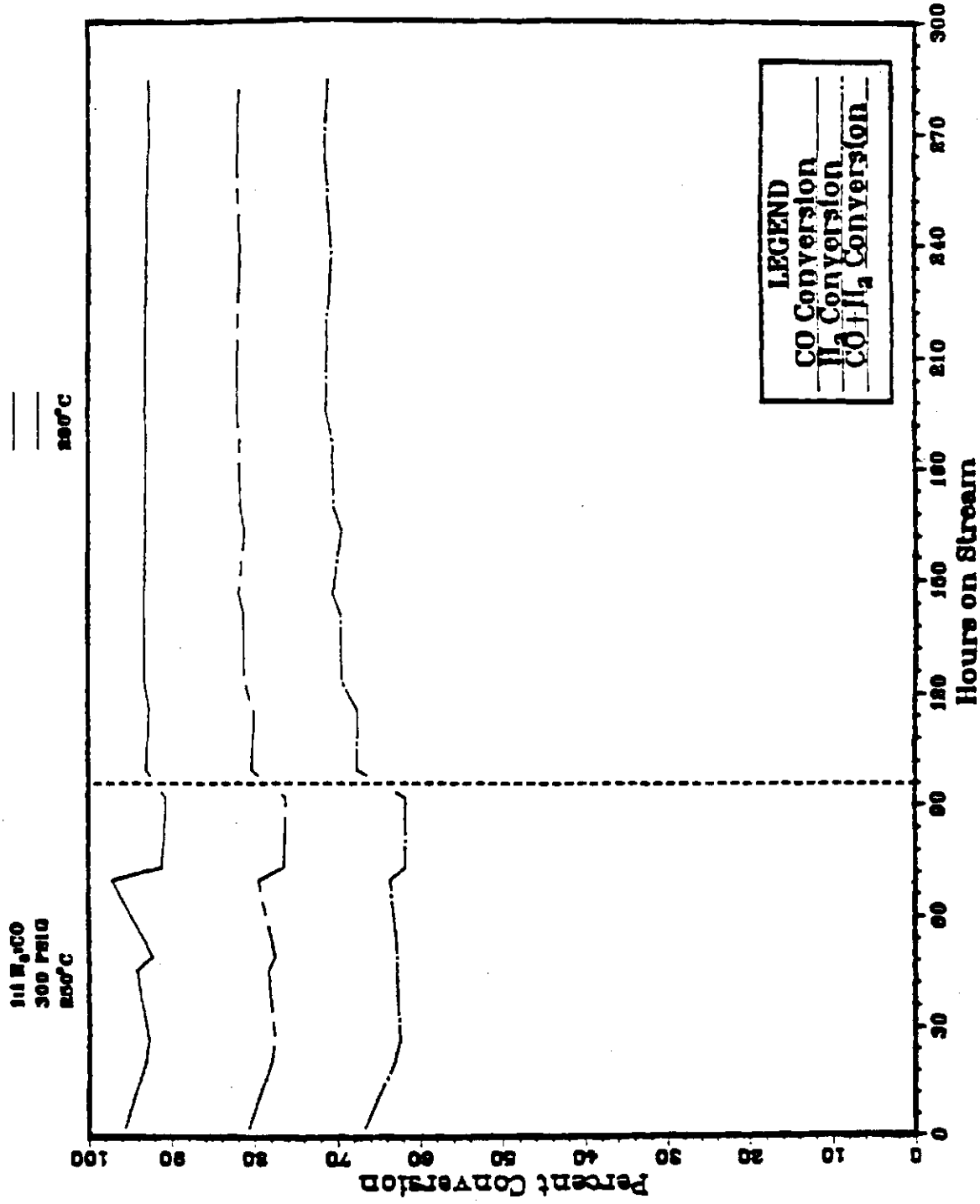


Fig. 67



1001110

Fig. 6B

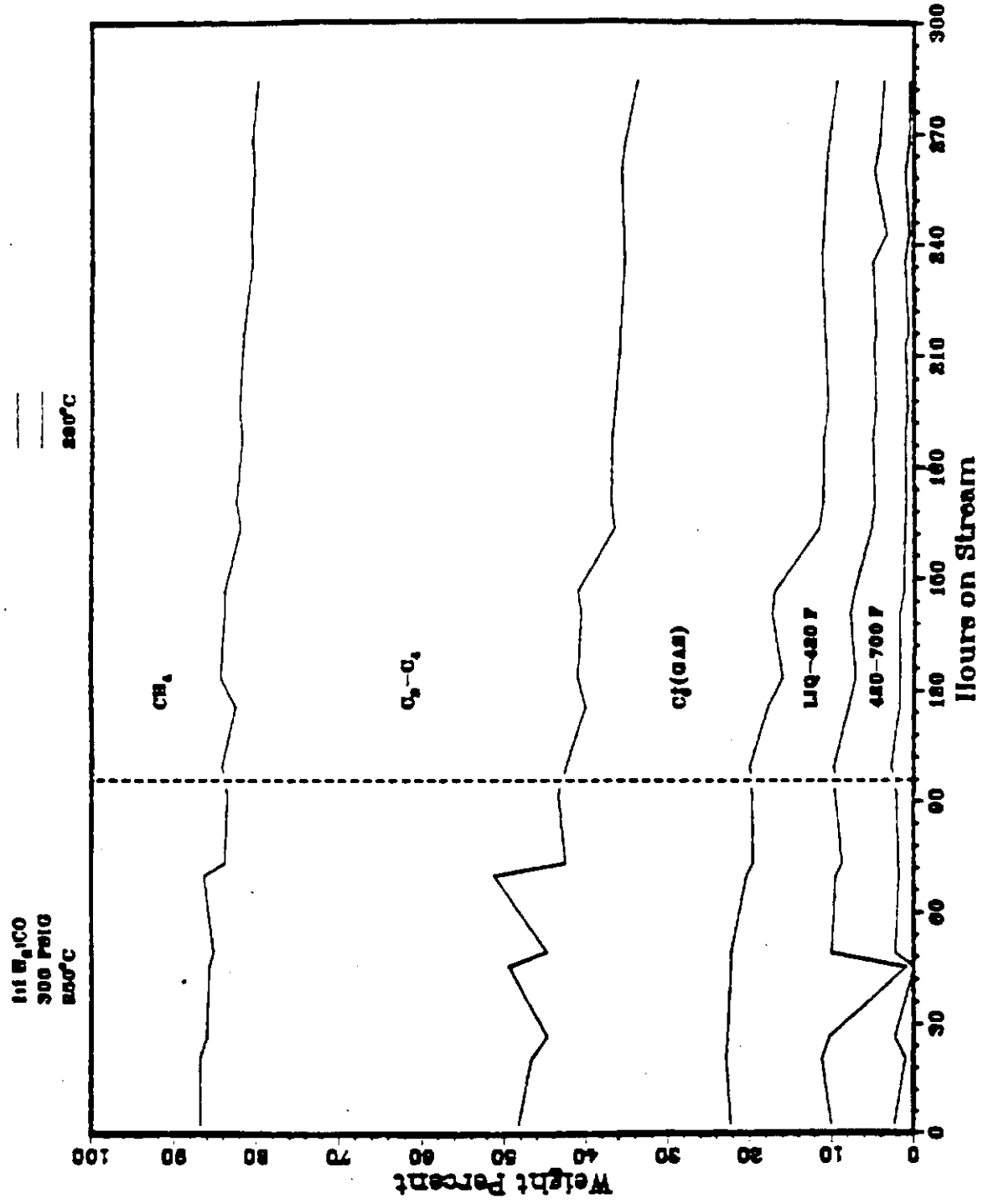


Fig. 69

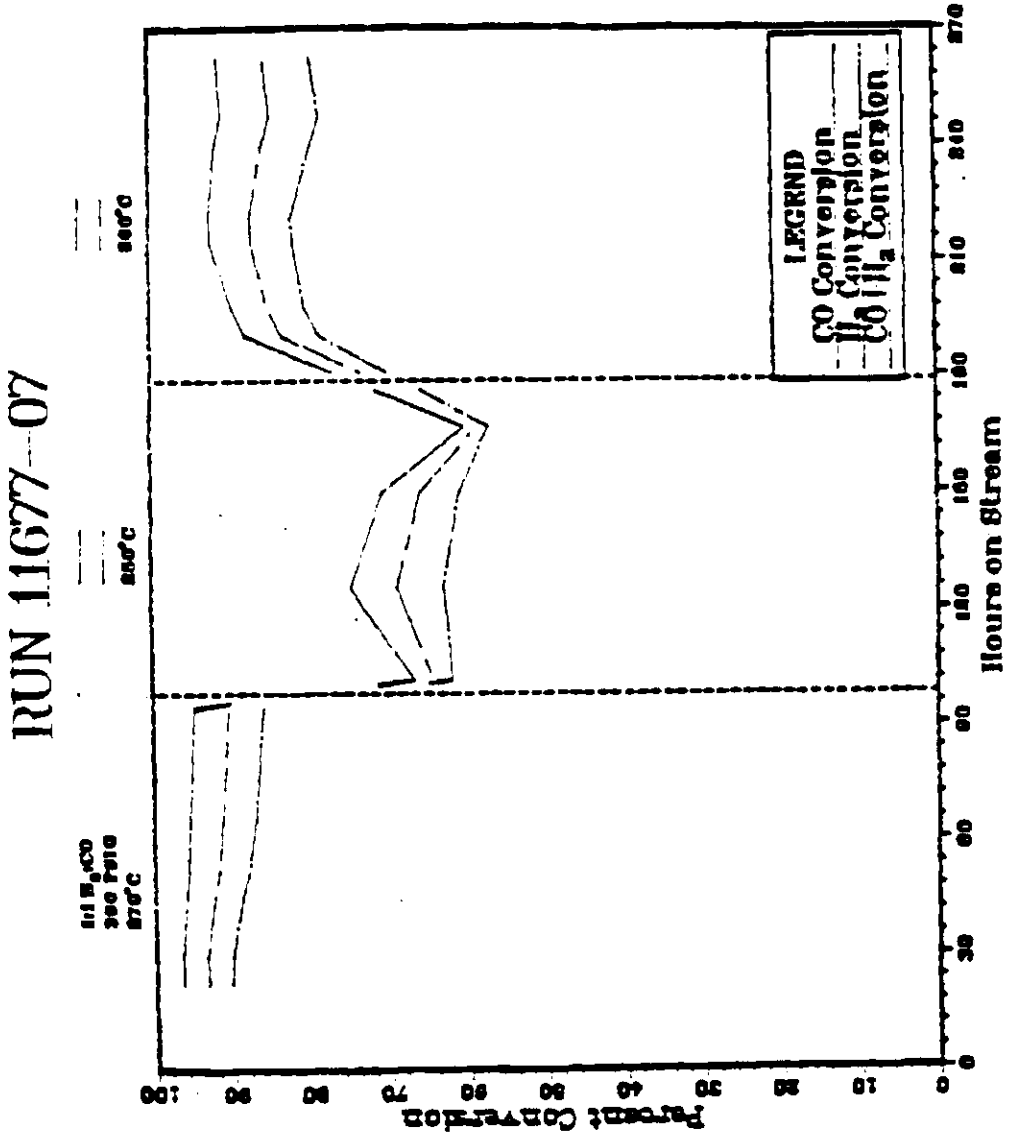

RUN 11677--07
Percent Conversion
Hours on Stream
LEGEND
CO Conversion
H_2 Conversion
$CO + H_2$ Conversion

Fig. 70

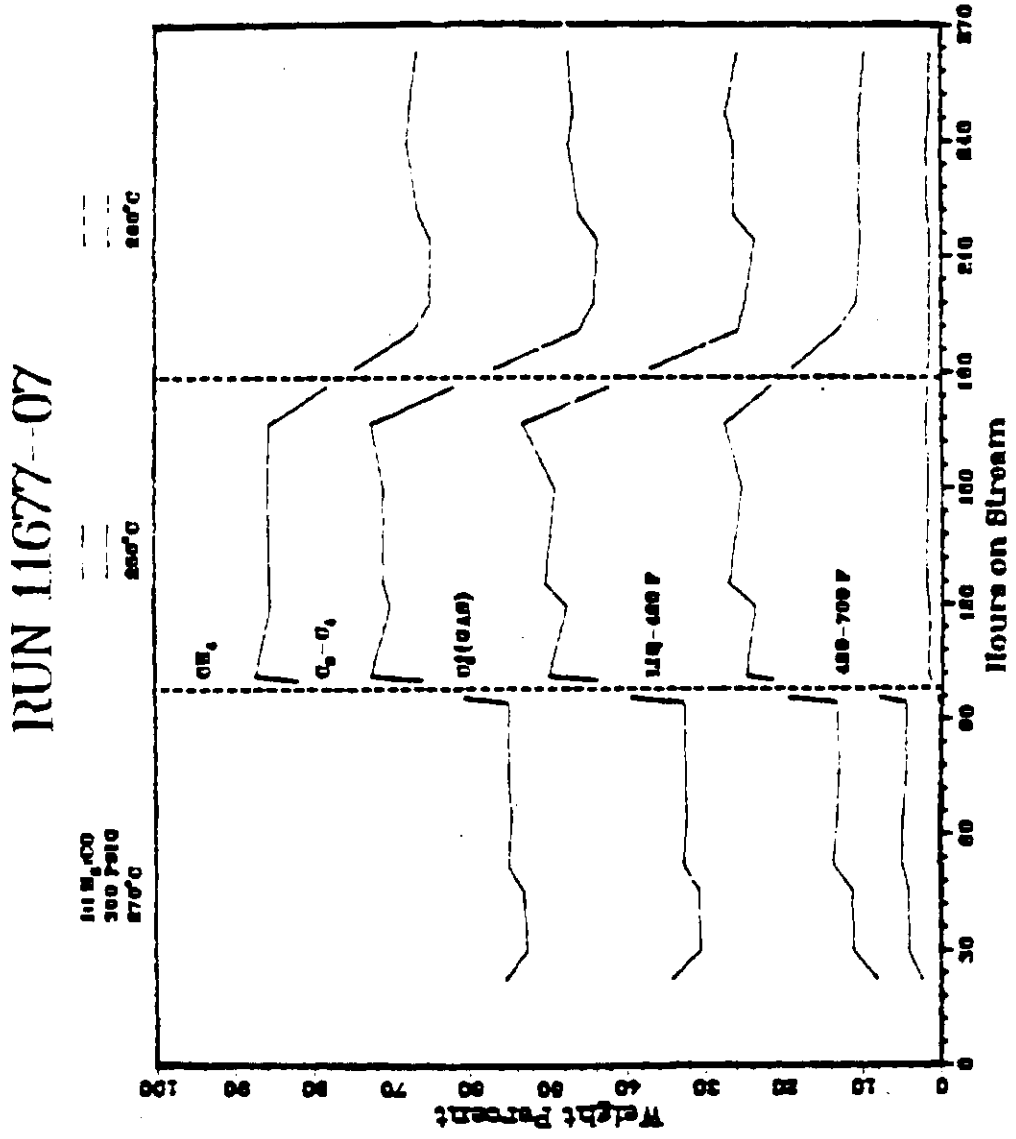


Fig. 71

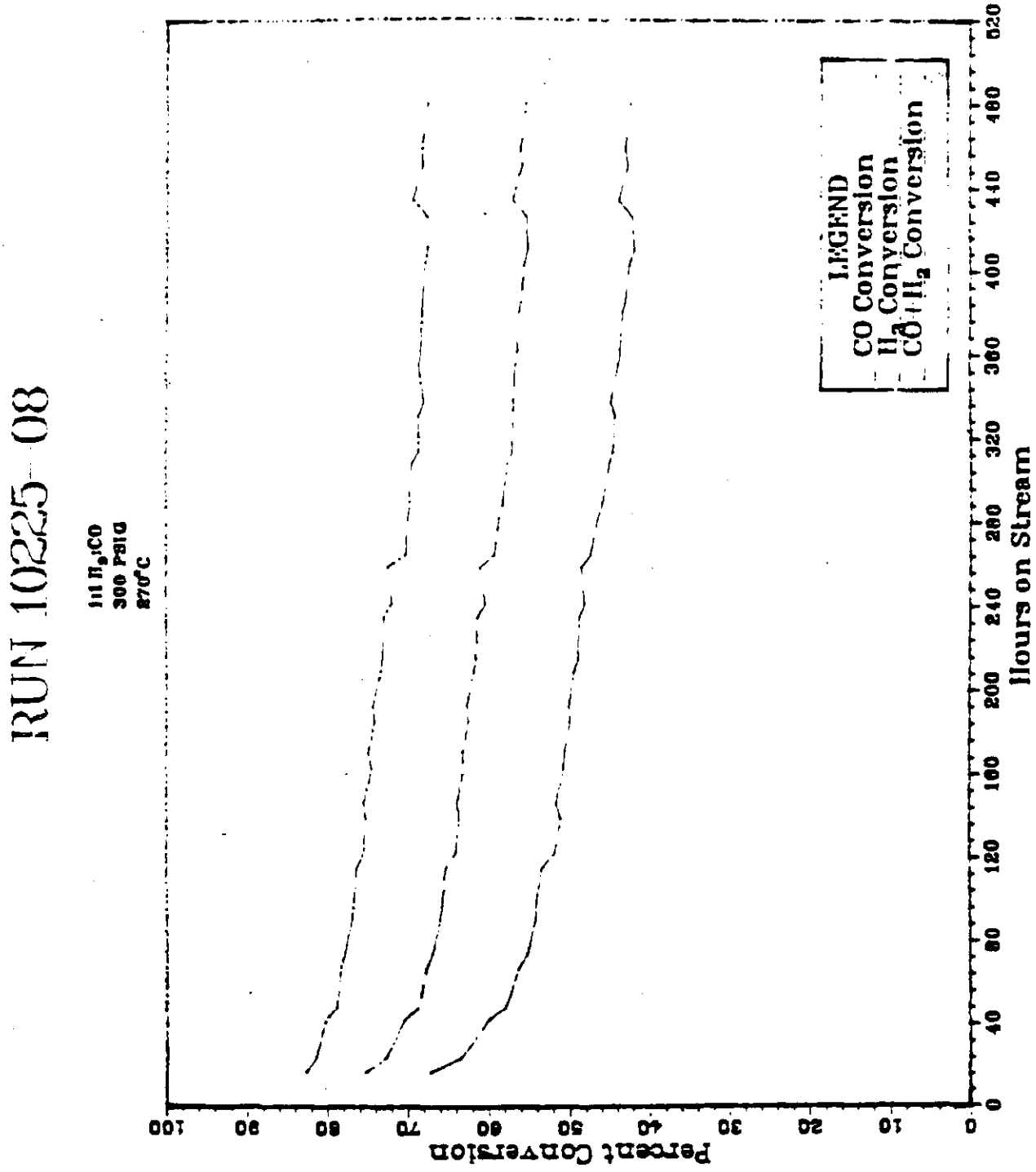

RUN 10225-08
1:1 H2:CO
300 PSIG
270°C
LEGEND
CO Conversion
H2 Conversion
CO + H2 Conversion
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
40
80
120
160
200
240
280
320
360
400
440
480
520

Fig. 72

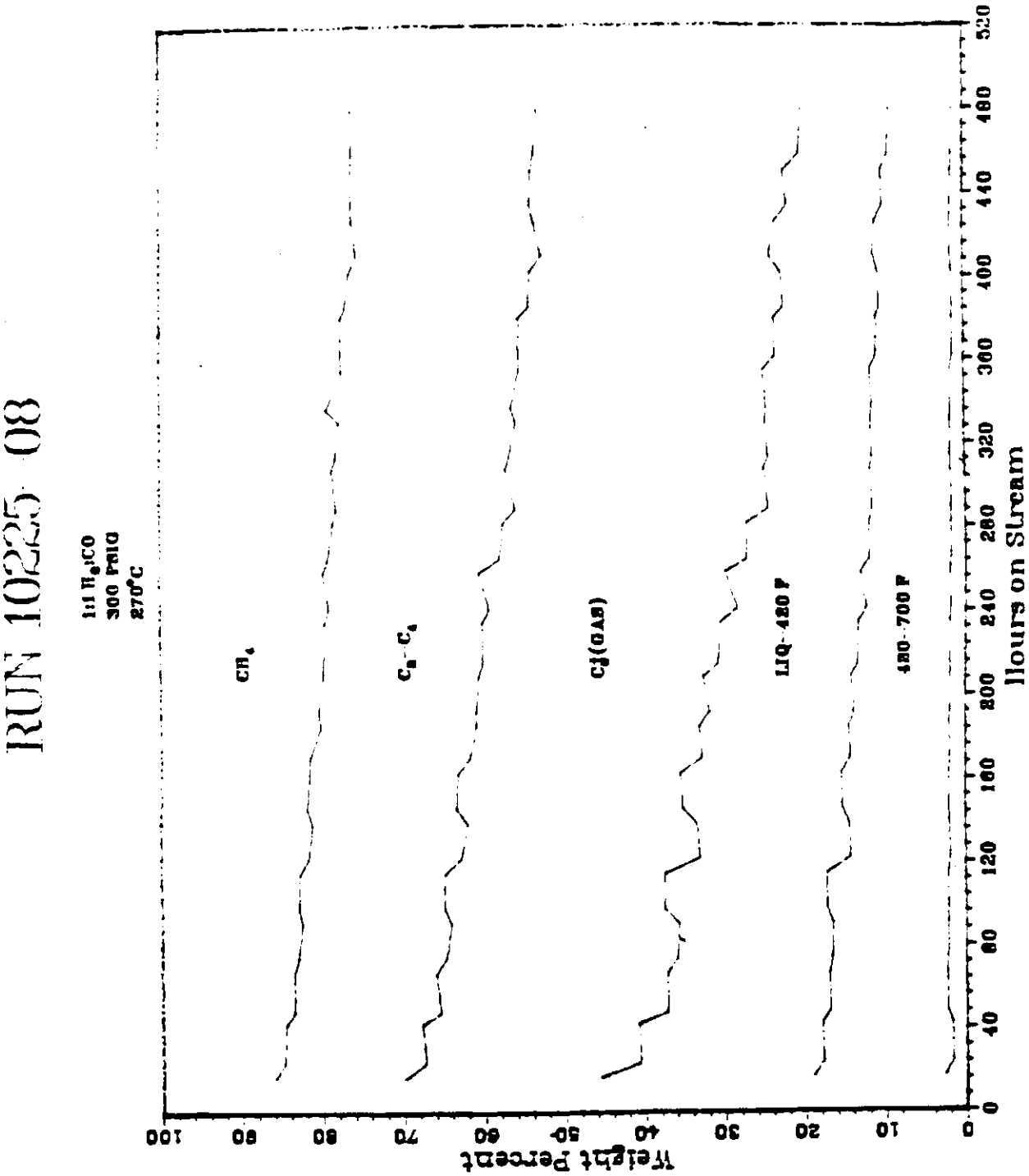

RUN 10225-08
1:1 H2:CO
300 PSIG
270°C
CH4
C2 - C4
C5(GAS)
LIQ-420 F
420-700 F
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
40
80
120
160
200
240
280
320
360
400
440
480
520

Fig. 73

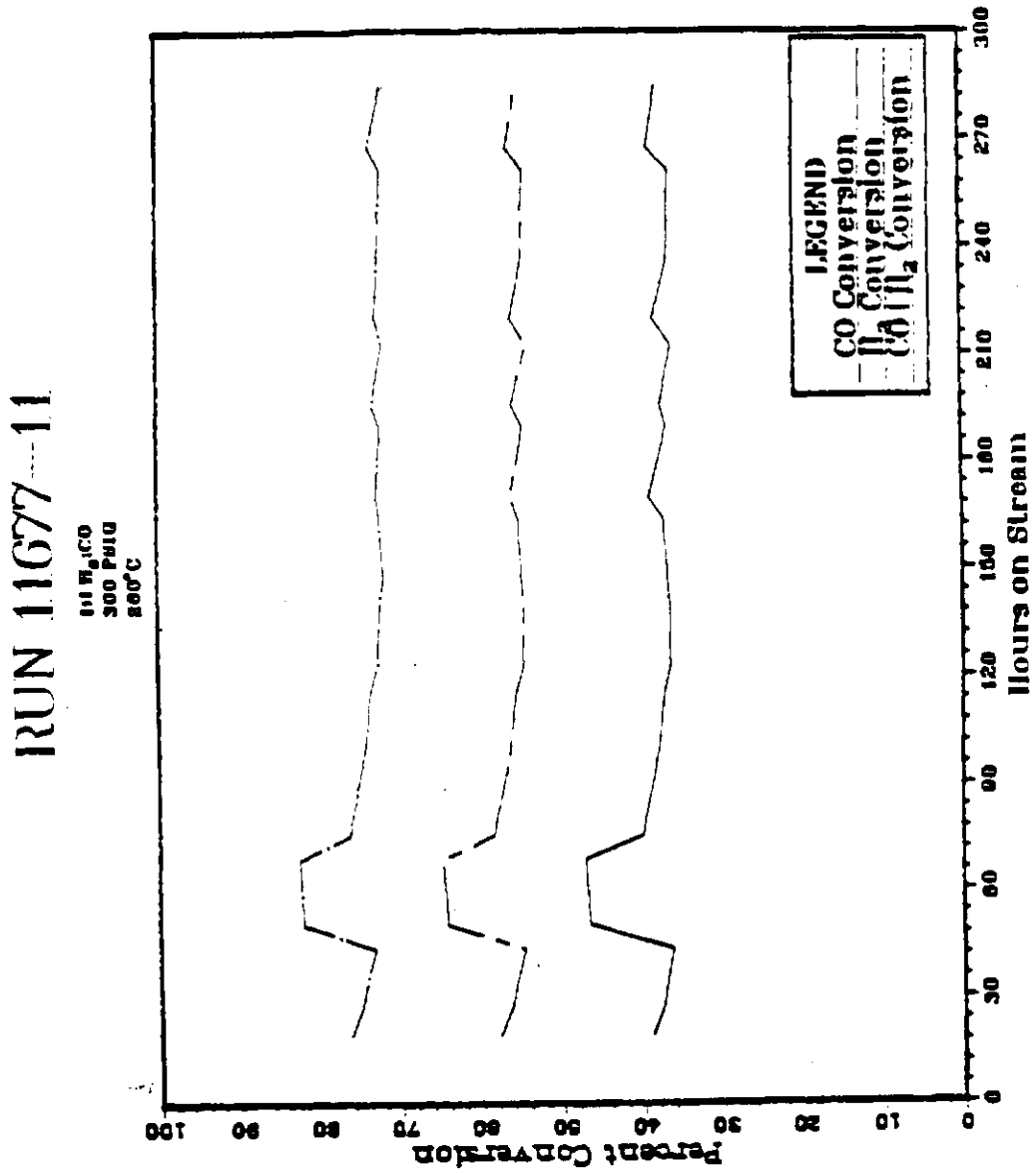

RUN 11677--11
300 Psig
280°C
LEGEND
CO Conversion
Percent Conversion
Hours on Stream
0
30
60
90
120
150
180
210
240
270
300
10
20
30
40
50
60
70
80
90
100

Fig. 74

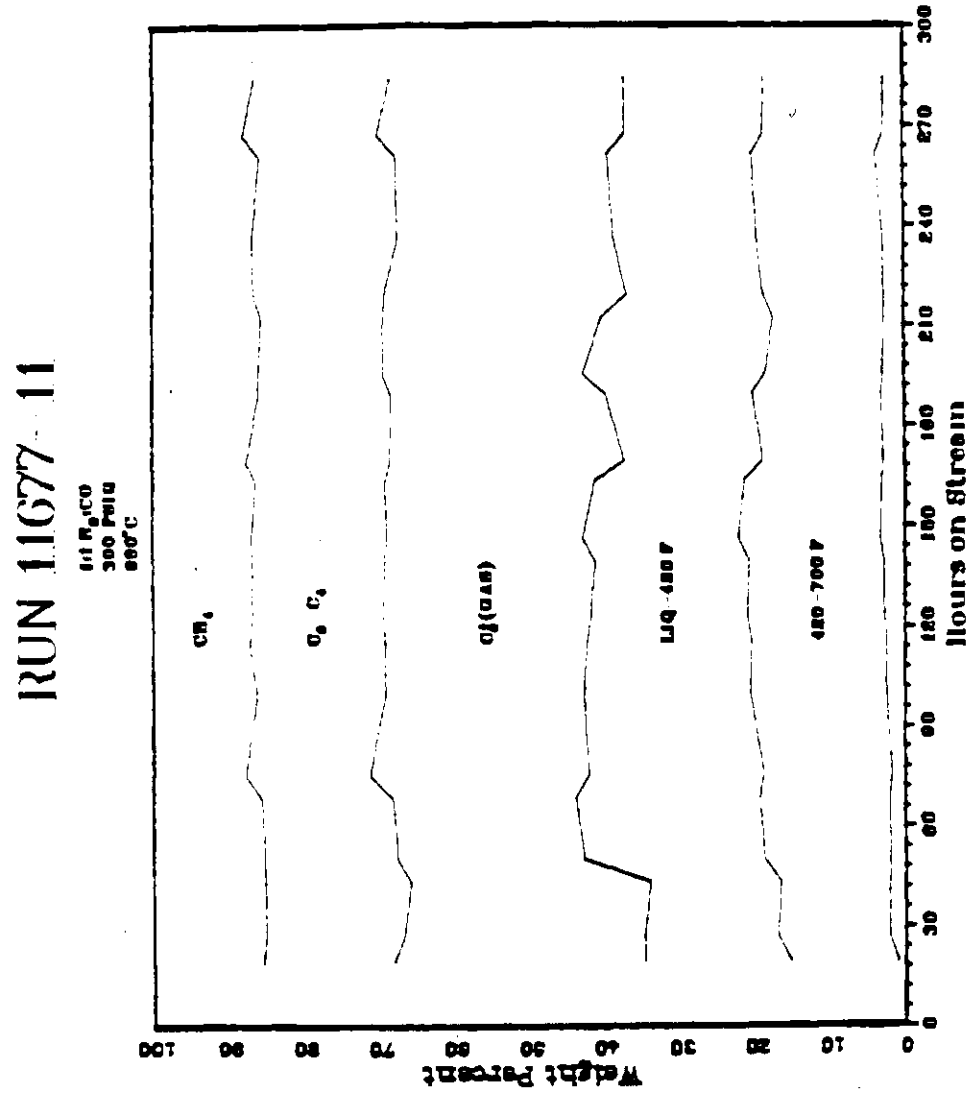

RUN 11677-11
Weight Percent
Hours on Stream
0
30
60
90
120
150
180
210
240
270
300
10
20
30
40
50
60
70
80
90
100

Fig. 75

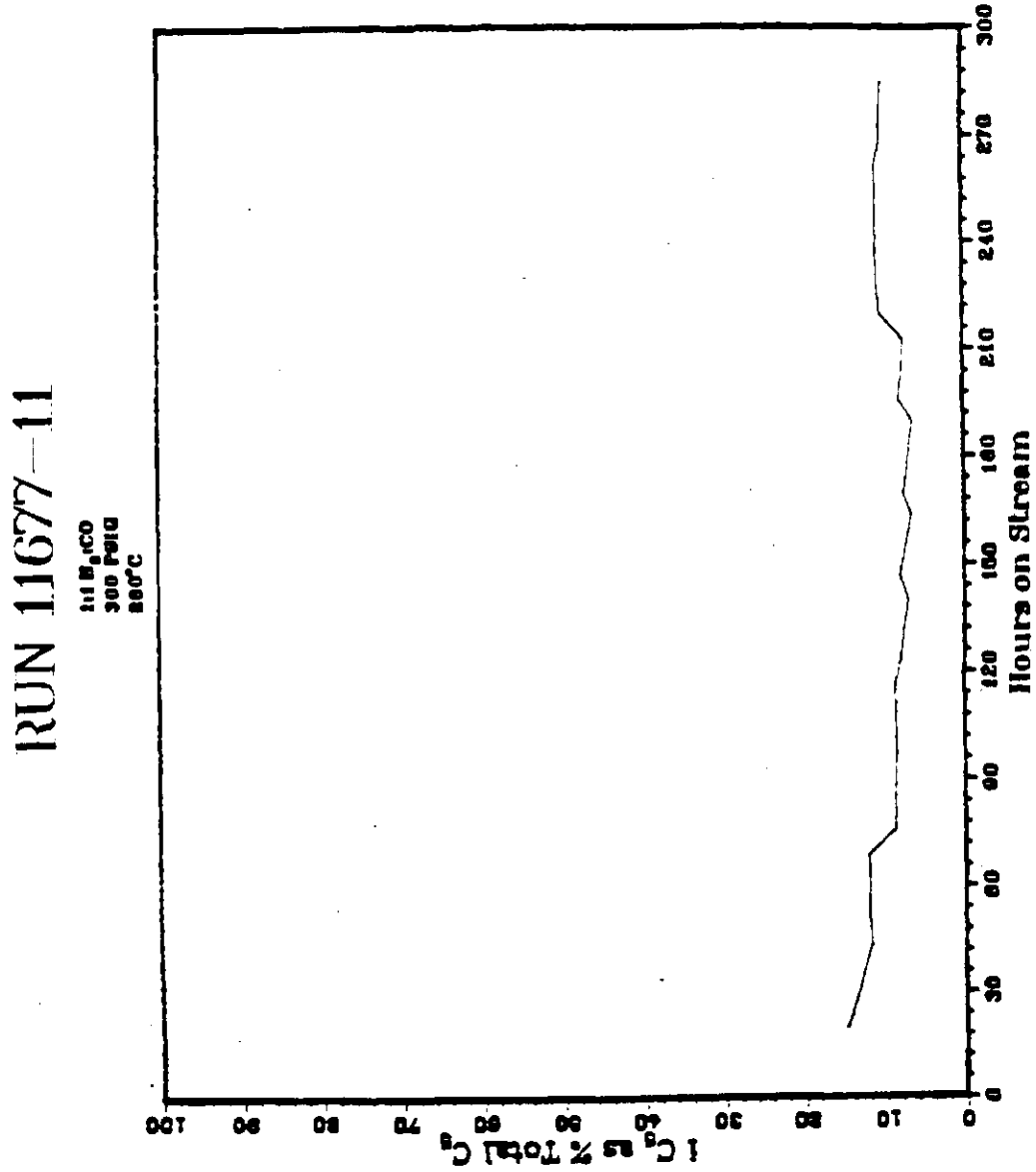

RUN 11677-11
1:1 H2:CO
300 PSIG
280°C
i C5 as % Total C5
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
30
60
90
120
150
180
210
240
270
300

Fig. 76

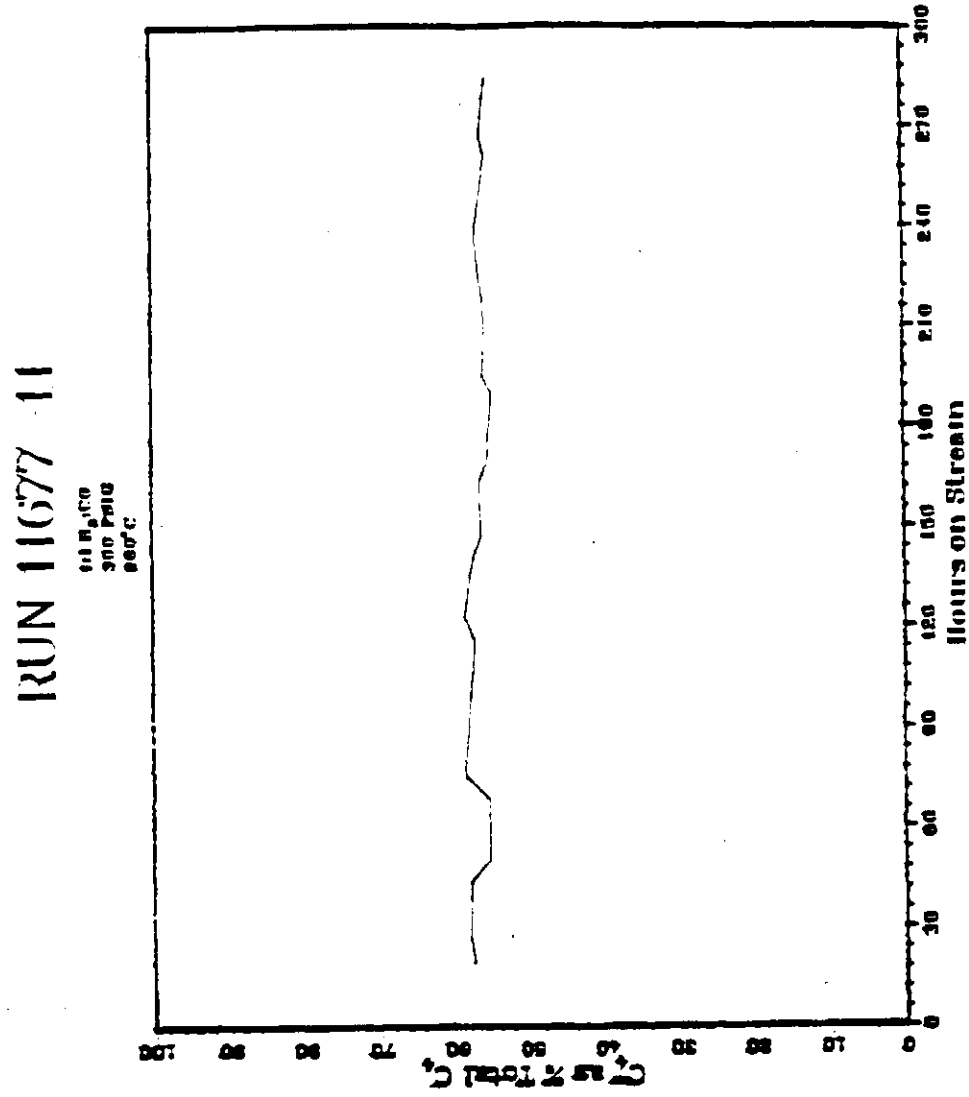

RUN 11677 11
Hours on Stream
0
30
60
90
120
150
180
210
240
270
300
C4 as % Total C4
0
10
20
30
40
50
60
70
80
90
100

Fig. 77

SCHEMATIC DIAGRAM OF UNION CARBIDE
TUBULAR REACTOR SIMULATION PROGRAMS
INPUT/OUTPUT RELATIONS

THE BERTY REACTOR, a CSTR (CONTINOUS-FEED STIRRED TANK REACTOR) operates under steady state conditions with a high internal recycle rate, causing the catalyst to be exposed to a known and unvarying gas phase composition

↓

YIELDS DATA

↓

DATA CORRELATION by MULTIPLE REGRESSION FOR:

1. CO Conversion Rate as a function of partial pressures of H2, CO and Temp. in the Power Law form
2. Wt%CH4 as a function of H2/CO ratio and Temp.
3. Schulz-Flory alpha as a function of H2/CO ratio and Temp.

is put ↓ into

INPUTS ===>	The FIXED program	===> OUTPUTS
1. CATALYST PROPERTIES . Specific Activity . Usage Ratio . Bulk Density 2. FEED GAS CONDITIONS . Space Velocity . H2/CO Ratio 3. REACTOR CONDITIONS . Pressure . Temperature . Recycle ratio	which is a simulation of an isothermal packed bed tubular reactor having a recycle stream, a condenser, a knock-out pot (to remove H2O & C5+ products) and off-gas stream	PRODUCT STREAM QUANTITIES: . H2 & CO Conversion . H2O & CO2 Production . CH4 make . C2+ hydrocarbon production

Fig. 78 Schematic diagram of the F-T reactor system.

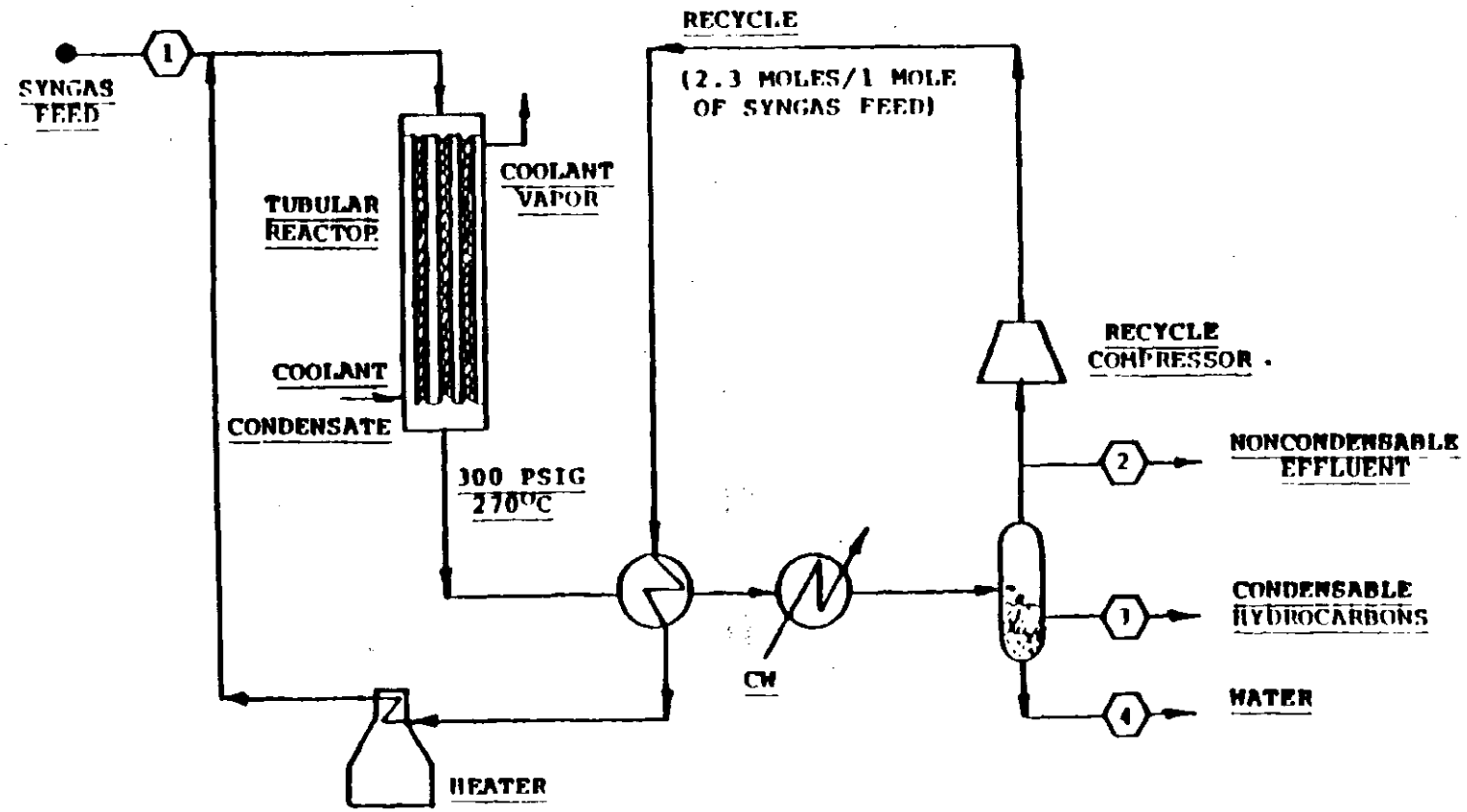
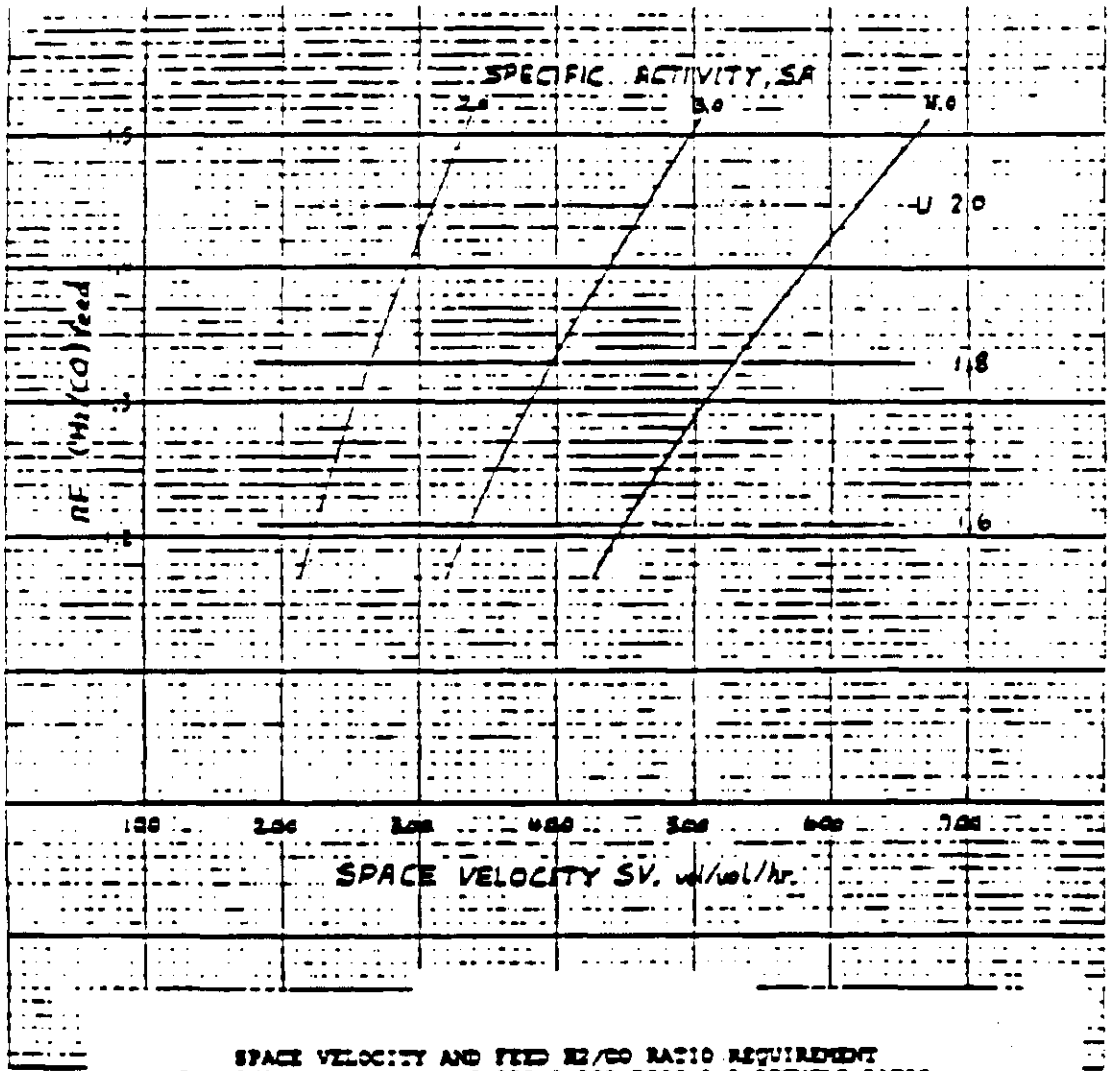
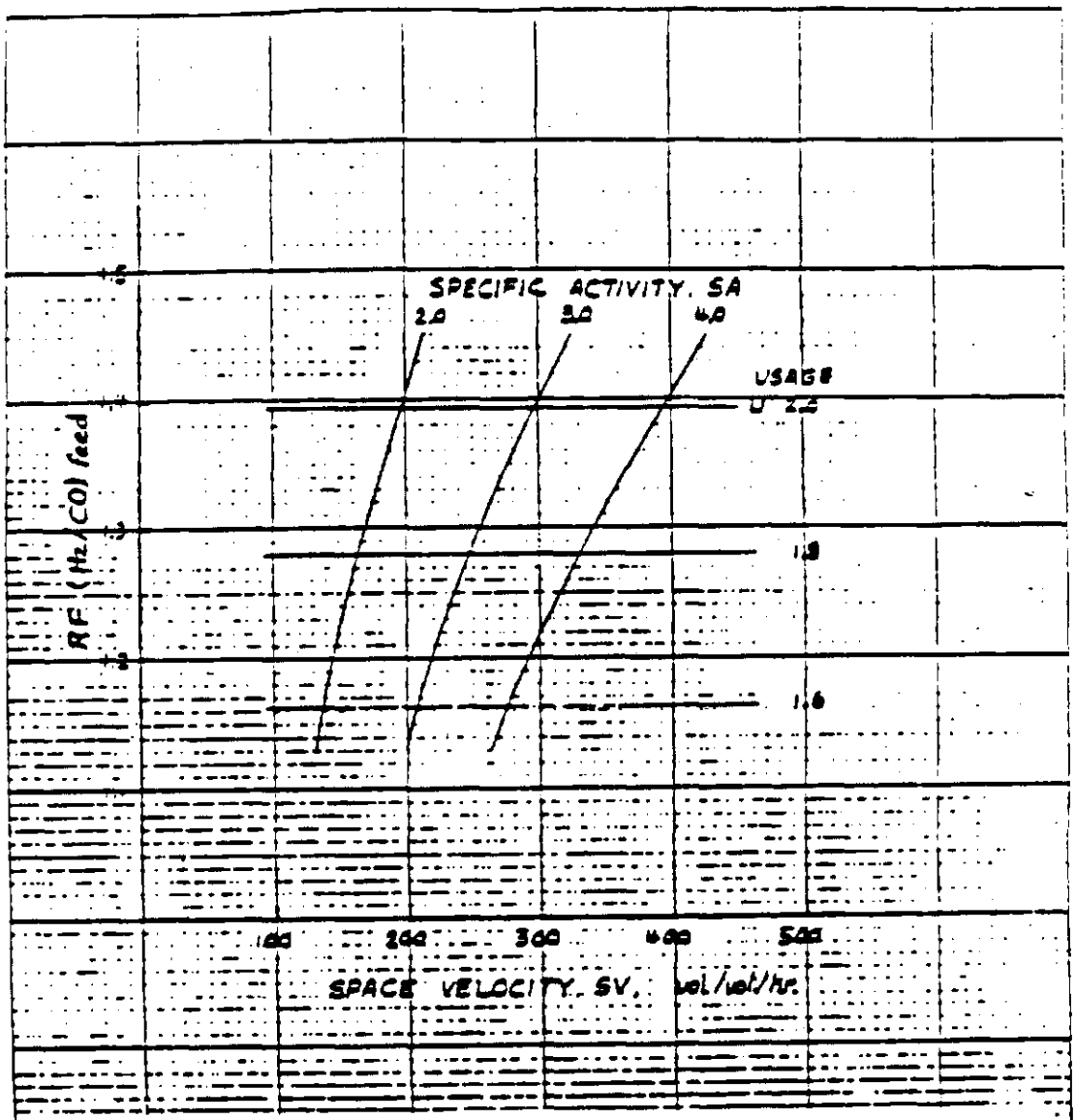


FIG. 79



SPACE VELOCITY AND FEED H2/CO RATIO REQUIREMENT
FOR TUBULAR REACTOR AT 270 C 300 PSIG 2.3 RECYCLE RATIO
WITH A CATALYST CAPABLE OF CERTAIN USAGE RATIO U
SPECIFIC ACTIVITY SA, AND BULK DENSITY 0.6 GM/CC
FOR 85 % SYNGAS CONVERSION AND 12.3 WT%CH4 PRODUCT SELECTIVITY

Fig. 80



SPACE VELOCITY AND FEED H2/CO RATIO REQUIREMENT
FOR TUBULAR REACTOR AT 270 C 300 PSIG 2.3 RECYCLE RATIO
WITH A CATALYST CAPABLE OF CERTAIN USAGE RATIO U
SPECIFIC ACTIVITY SA. AND BULK DENSITY 0.6 GM/CC
FOR 85 % SYNGAS CONVERSION AND 7.8 WT%CH4 PRODUCT SELECTIVITY