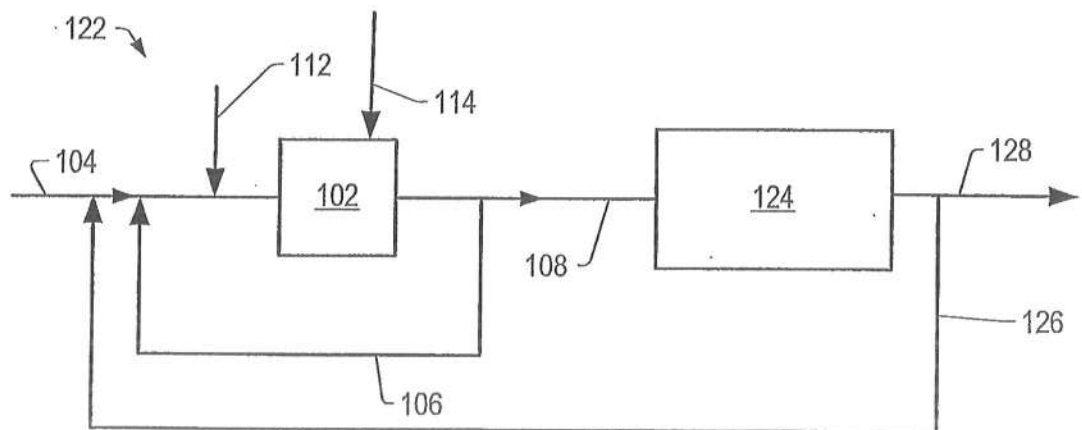
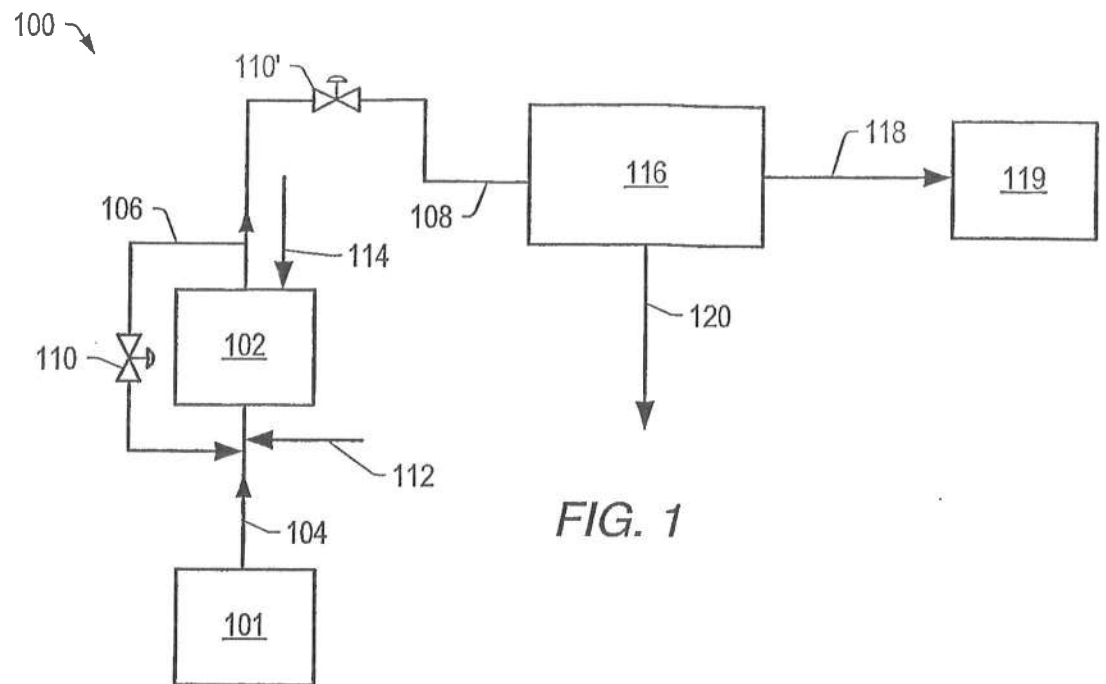
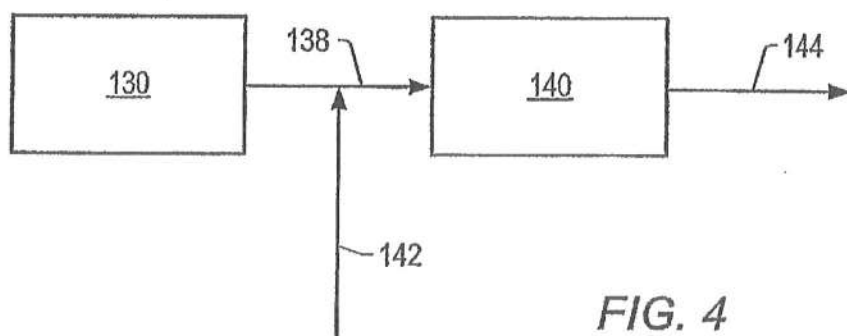
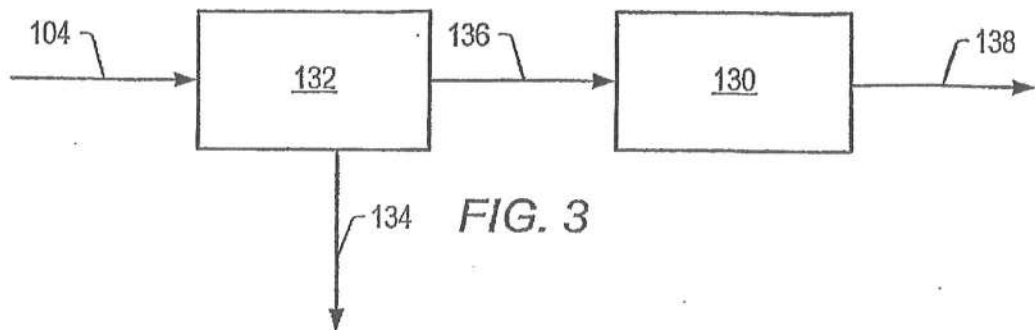






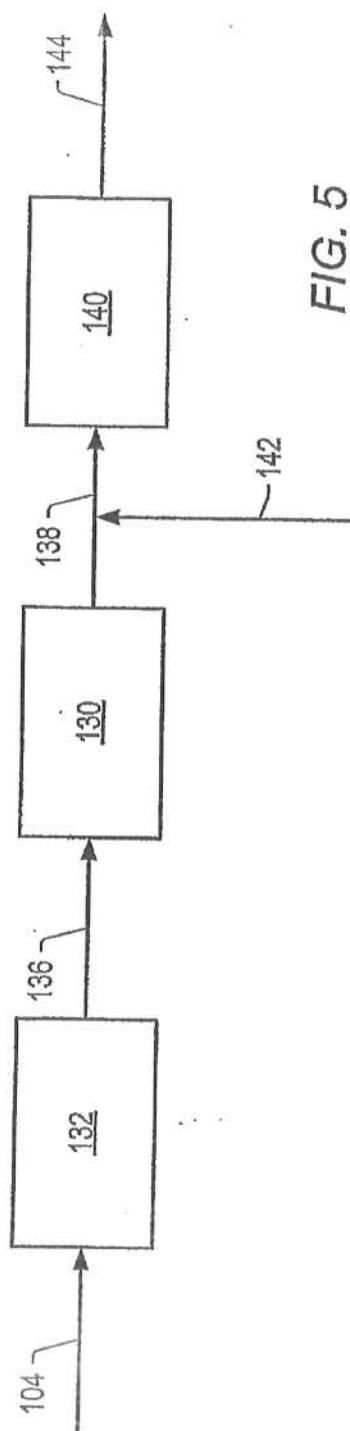


FIG. 5

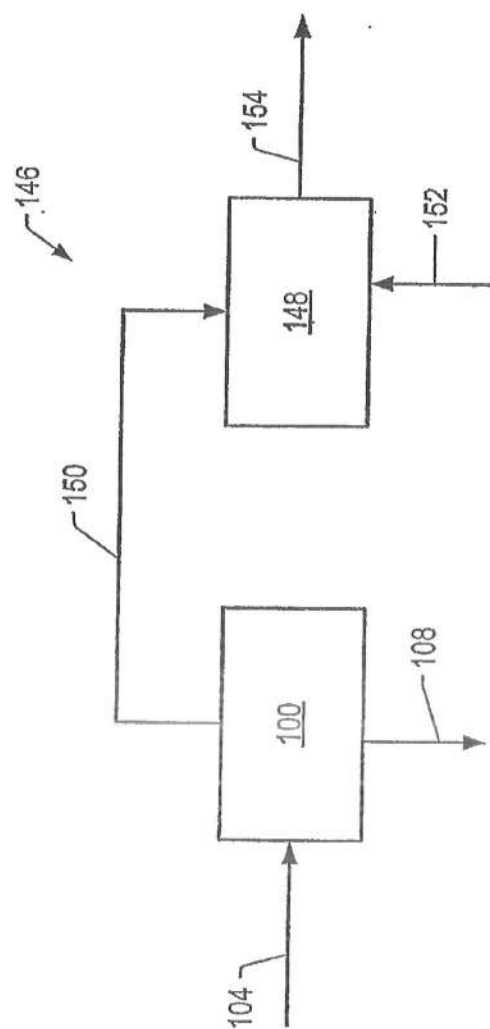


FIG. 6

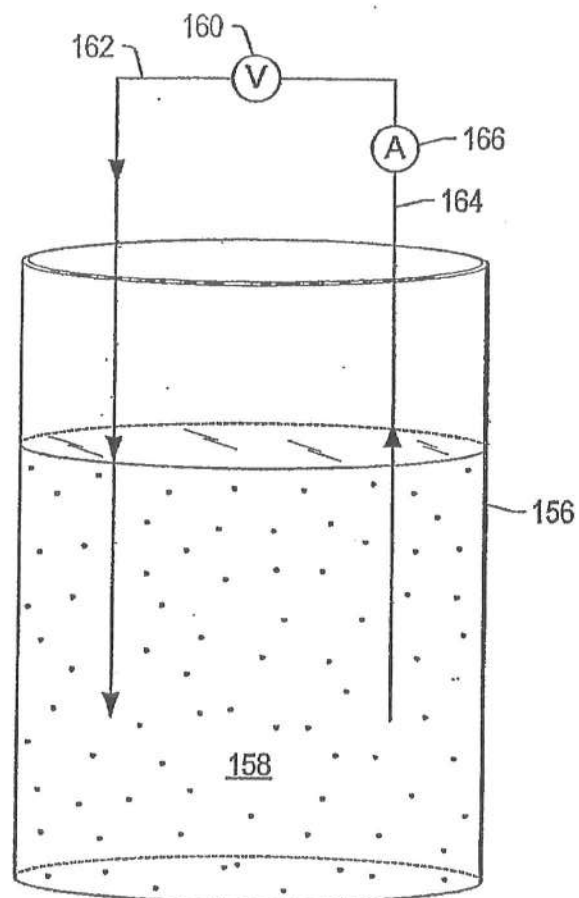


FIG. 7

TABLE 1

Property	Crude Feed	Crude Product	Crude Product
Example		2	4
Ratio of hydrogen to crude feed, Nm ³ /m ³	-----	8000	16000
Hydrogen Content, wt%	10.6	11.6	11.5
Carbon Content, wt%	84.3	86	85.9
H/C ratio	1.5	1.6	1.6
Oxygen Content, wt%	0.5	-----	-----
Nitrogen Content, wt%	0.4	0.3	0.3
Sulfur Content, wt%	4.1	1.8	2.0
Nickel Content, wtppm	63.6	<1	<2
Vanadium Content, wtppm	149	<1	<1
Iron Content, wtppm	7.3	<1	<1
Micro-Carbon Residue, wt%	13.73	*	*
C ₅ Asphaltenes, wt%	18.72	*	*
TAN	1.1	<0.1	<0.1
Density at 15.56 °C (60 °F), g/cm ³	1.0034	0.916	0.9301
API Gravity at 15.56 °C (60 °F)	9.38	22.82	20.6
Viscosity, Pa·s (cP)	21.7 (21,725) @ 37.8 °C (100 °F)	0.008 (7.9) @ 40 °C (104 °F)	0.017 (17.2) @ 40 °C (104 °F)
Boiling Range Distribution	ASTM D5307 °C (°F)	ASTM D2887 °C (°F)	ASTM D2887 °C (°F)
IBP	207 (405)	54 (129)	97 (206)
5%	302 (576)	128 (262)	187 (369)
10%	336 (636)	178 (353)	238 (461)
15%	363 (683)	222 (431)	273 (524)
30%	422 (792)	301 (574)	342 (647)
50%	496 (925)	364 (687)	402 (756)
60%	537 (999)	391 (736)	427 (801)
70%	>538 (1000)	417 (783)	452 (845)
90%	>538 (1000)	480 (896)	506 (942)
95%	>538 (1000)	505 (941)	527 (980)
Final Boiling Point	>538 (1000)	553 (1028)	581 (1078)
Weight Percentage of Components in Crude Feed and Crude Product (ASTM D2892 and D5236)			
Component	Crude Feed	Crude Product	Crude Product
Naptha Components wt%	0.14	11.8	7.5
Kerosene Components wt%	0.80	8.4	7.7
Diesel Components wt%	6.42	20.7	18.8
Distillate Components wt%, (kerosene plus diesel)	7.20	29.1	26.5
VGO Component, wt%	38.7	55.6	61.1
Residue, wt%	53.8	2.8	4.4
Coke, wt%	Not detected	Not detected	Not detected

FIG. 8

TABLE 2

Weight Percentage of Hydrocarbon Components in Crude Feed and Non-Condensable Hydrocarbons Produced at 8000 Nm ³ /m ³ Using the TMS Catalyst		
Component	Crude Feed	Non-Condensable Hydrocarbons
Example	2	2
Methane, wt%	0	26.9
Ethane, wt%	0	19
Ethylene, wt%	0	1.5
Propane, wt%	0	18.9
Propylene, wt%	0	5
n-Butane, wt%	0	14.4
Iso-butane, wt%	0	2.8

FIG. 9

TABLE 3

Example	2						4			
	8000						16000			
Ratio of hydrogen to crude feed, Nm ³ /m ³										
	Naphtha	Kerosene	Diesel	VGO	Naphtha	Kerosene	Diesel	VGO		
Hydrogen Content, wt%	13.88	12.19	11.75	11.01	13.54	12.18	11.78	11.08		
Carbon Content, wt%	85.2	85.1	85.77	86.41	85.34	85.01	85.54	86.21		
Nitrogen Content, wt%	0.12	0.17	0.19	0.42	0.17	0.16	0.16	0.40		
Sulfur Content	0.65	2.38	2.13	1.87	0.95	2.46	2.25	2.01		
n-Paraffins, wt%	20.5	Non-Aromatic Aromatic 62.6	Non-Aromatic Aromatic 52.0	Non-Aromatic Aromatic 43.3	17.4	Non-Aromatic Aromatic 62.5	Non-Aromatic Aromatic 50.1	Non-Aromatic Aromatic 37.8		
Isoparaffins, wt%	25.4				22.1					
Olefins, wt%	7.8				4.8					
Naphthenes, wt%	16.7				13.4					
C ₁₄ +, wt%	0.1				0.1					
Other components, wt%	9.9				18.6					
Multi-substituted aromatics, wt%	13.2	---	---	---	16.1	---	---	---		
Monocyclic ring Aromatics, wt%	19.5	23.9	---	---	22.7	23.8	---	---		
Benzene, wt%	0.3	---	---	---	0.12	---	---	---		
Polyaromatic, wt%	0.3	13.5	---	---	0.8	13.7	---	---		
Total Aromatics, wt%	19.7	37.4	48.0	56.7	23.5	37.5	49.9	62.3		
Freezing Point, °C		-43.4				-39.5				
Octane Number	74.9				80.4					

FIG. 10

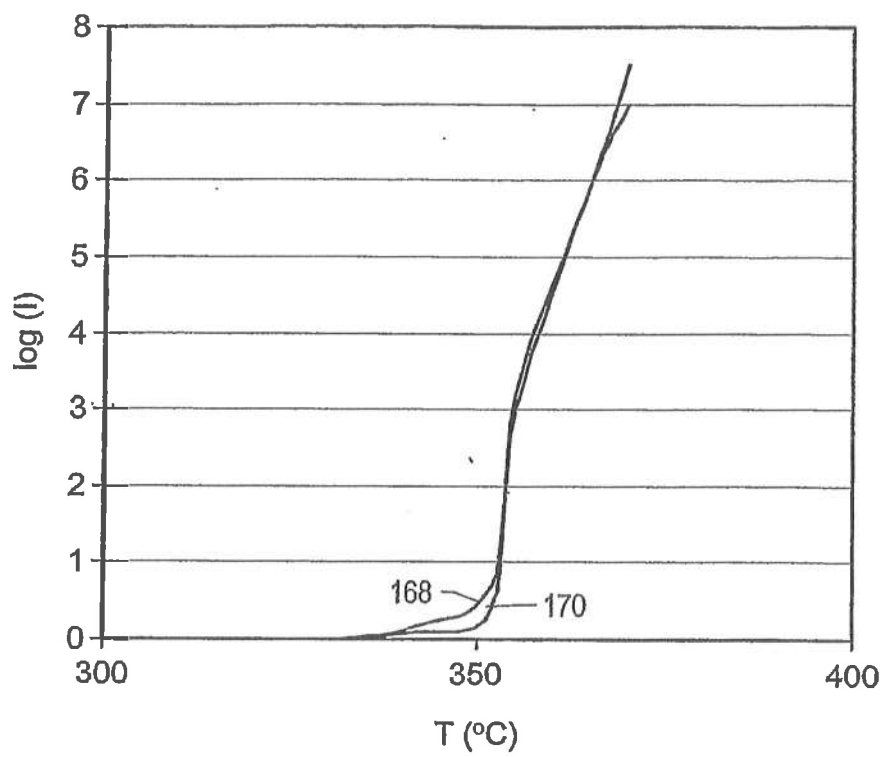


FIG. 11

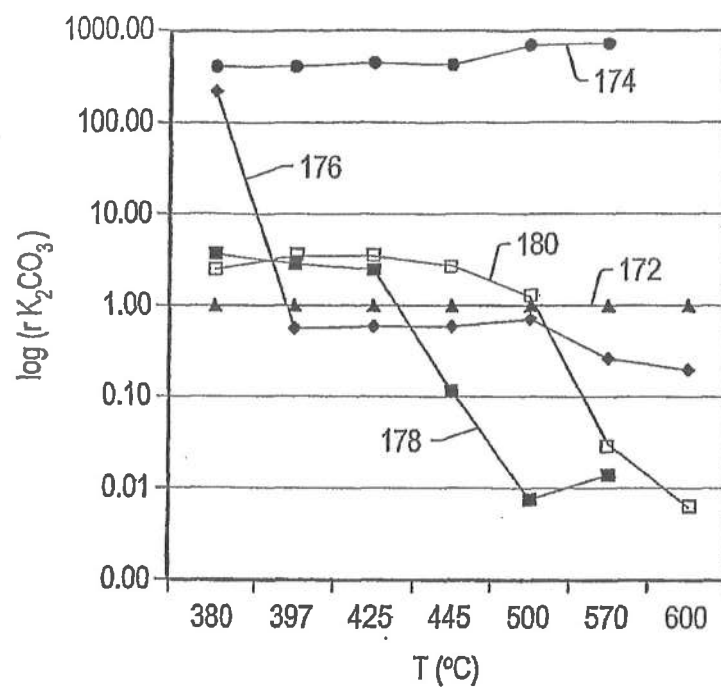


FIG. 12

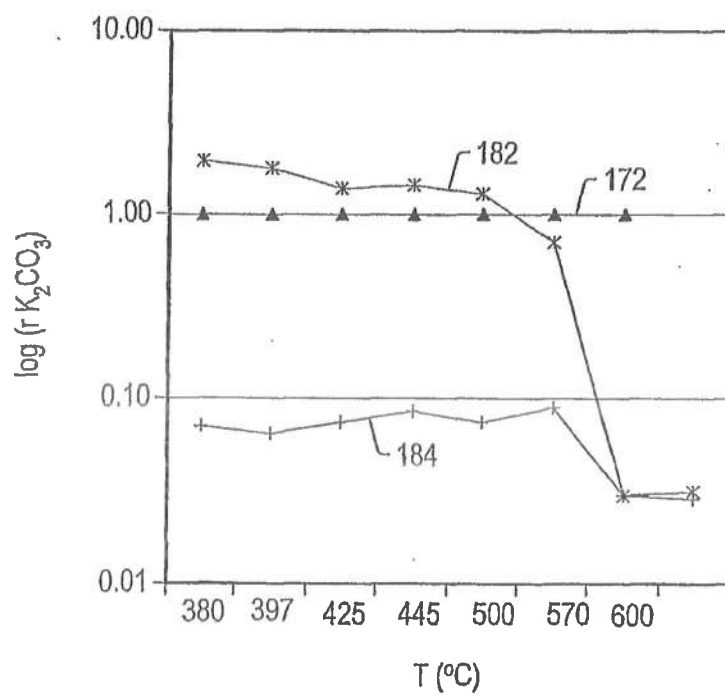


FIG. 13

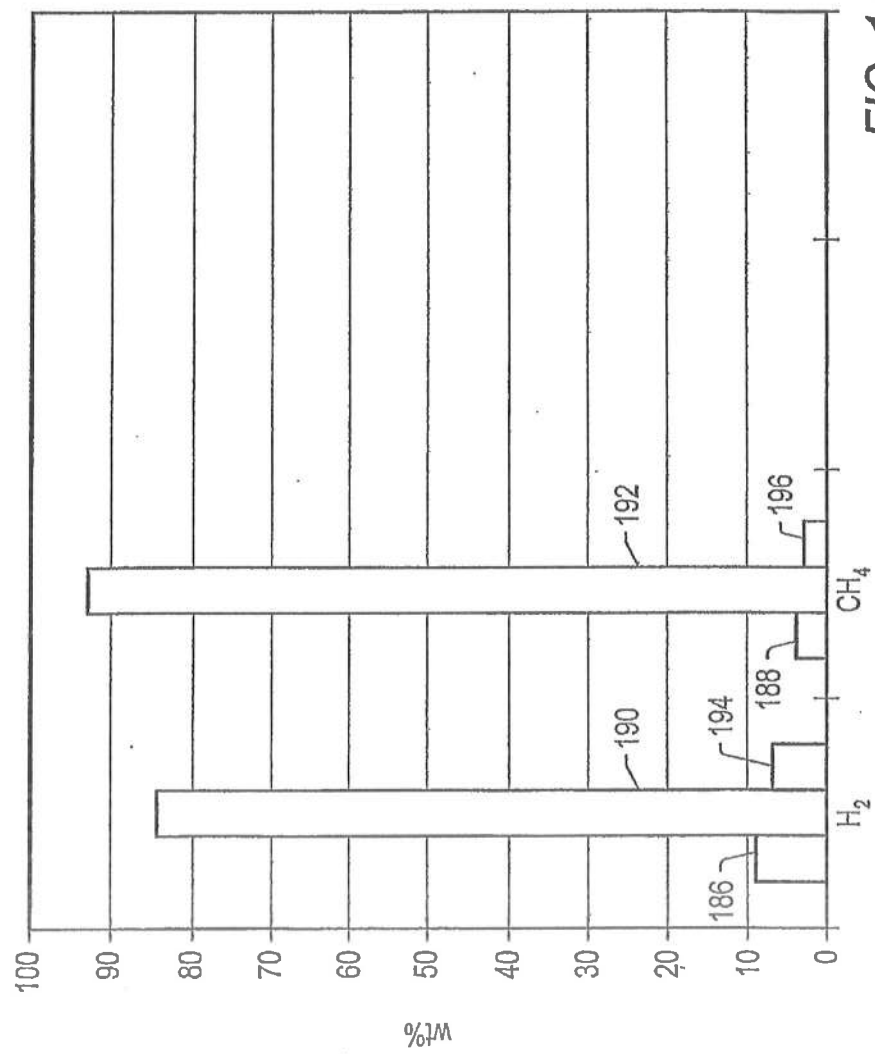


FIG. 14

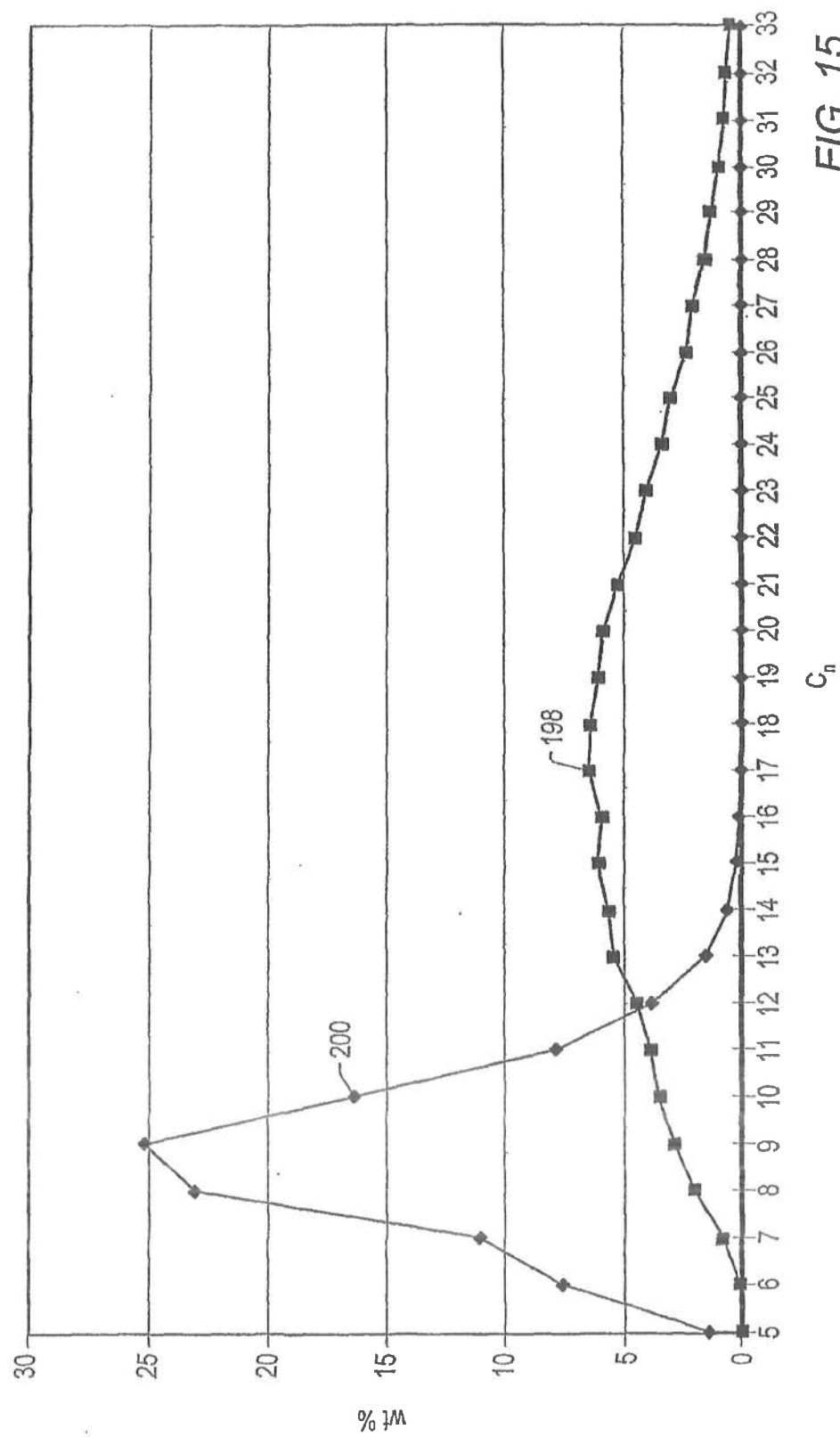


FIG. 15

TABLE 4

Example Number	Catalyst	Contacting Temperature, °C	Steam, flow rate, g/min	H ₂ flow rate at 0.1 MPa, cm ³ /min	Crude Product, wt%	Gas Produced, wt%	Coke Produced, wt%	Sulfur Content in Crude Product, wt%	Atomic H/C in Crude Product
17	K ₂ CO ₃ /Rb ₂ CO ₃ /Cs ₂ CO ₃	375	0.4	250	79	2	17	1	1.8
18	K ₂ CO ₃ /Rb ₂ CO ₃ /Cs ₂ CO ₃	500 to 600	0 at 500 °C; 0.4 at 600 °C	250	85	5	9	0.8	1.8
19	CaCO ₃	500	0.4	250	82	9	9	>1	1.7
20	SiC	500	0	250	53	25	22	3.6	1.5

FIG. 16