Interchangers were similar to those in use in liquid phase stalls except that those in use in saturation stalls had 241 tubes. K value for both was 300-200.

Preheaters. On the saturation stalls the preheater consisted of 4 or 5 elements of 90 mm. bore, 127 mm. external diameter tube heated electrically. Normal gas-fired preheaters were used in splitting stalls - each contained about 25 elements of 90 mm. bore tube and had a K value of 200-180.

Reactors. The main feature of vapour phase hydrogenation reactors is the arrangement of the catalyst in beds with intermediate mixing chambers into which cold circulating gas is introduced in order to give the necessary temperature control. The Leuna engineers do not appear to have been very progressive as regards improvements in design of these bed converters and the operating staff seemed satisfied with the present reactors although they are capable of much smaller throughputs than those in use, for example, at Billingham.

The forging body was formerly lined with stamped cement asbestos. During the war, Leuna has used fired bricks of "Schammote stein" with apparent success.

Coolers. The K value of vapour phase hydrogenation stall coolers was stated to be 400-500 kg. cals/°C/M^2/hour.

E. Vapour Phase Splitting Hydrogenation at 700 atmospheres Pressure

This was not practised at Leuna but the research for the Dutzkendorf plant of the Wintershalle A. G. was done in the Leuna laboratories. Dr. Becker supplied comparative data for 300 ats. two stage (presaturation followed by splitting hydrogenation) and 700 ats. direct treatment over 6434 when using bituminous coal tar middle oil (creosote middle oil) as feed. These data are given in Fig. VII.

It will be seen that the weight yield of petrol of 30% volatility at 100°C is substantially the same in the two processes but that the high pressure method gives a product higher in anti-knock rating by 5-10 octane numbers. Dr. Becker was unable to give figures for hydrogen consumption but presumably the 700 ats. process requires less hydrogen because of the greater concentration of aromatics in the final product. Incidently this aromatic content and also the octane number of the petrol could be increased still further using a "diluted" catalyst such as is employed at Welheim instead of 6434.

In the 700 ats. process overall petrol production leistung is 0.37-0.38 kgs./litre catalyst/hour. This compares with 0.29 kgs./litre 5058 + 6434 catalyst/hour for the 300 ats. two stage method. Since 700 ats. converters have only 75% of the catalyst capacity of vessels of weight used for 300 ats., there is no saving in reaction vessels using the higher pressure process. Because the conversion/pass using 700 ats. and non-saturated feed is low - 43%, the amount of distillation involved is rather

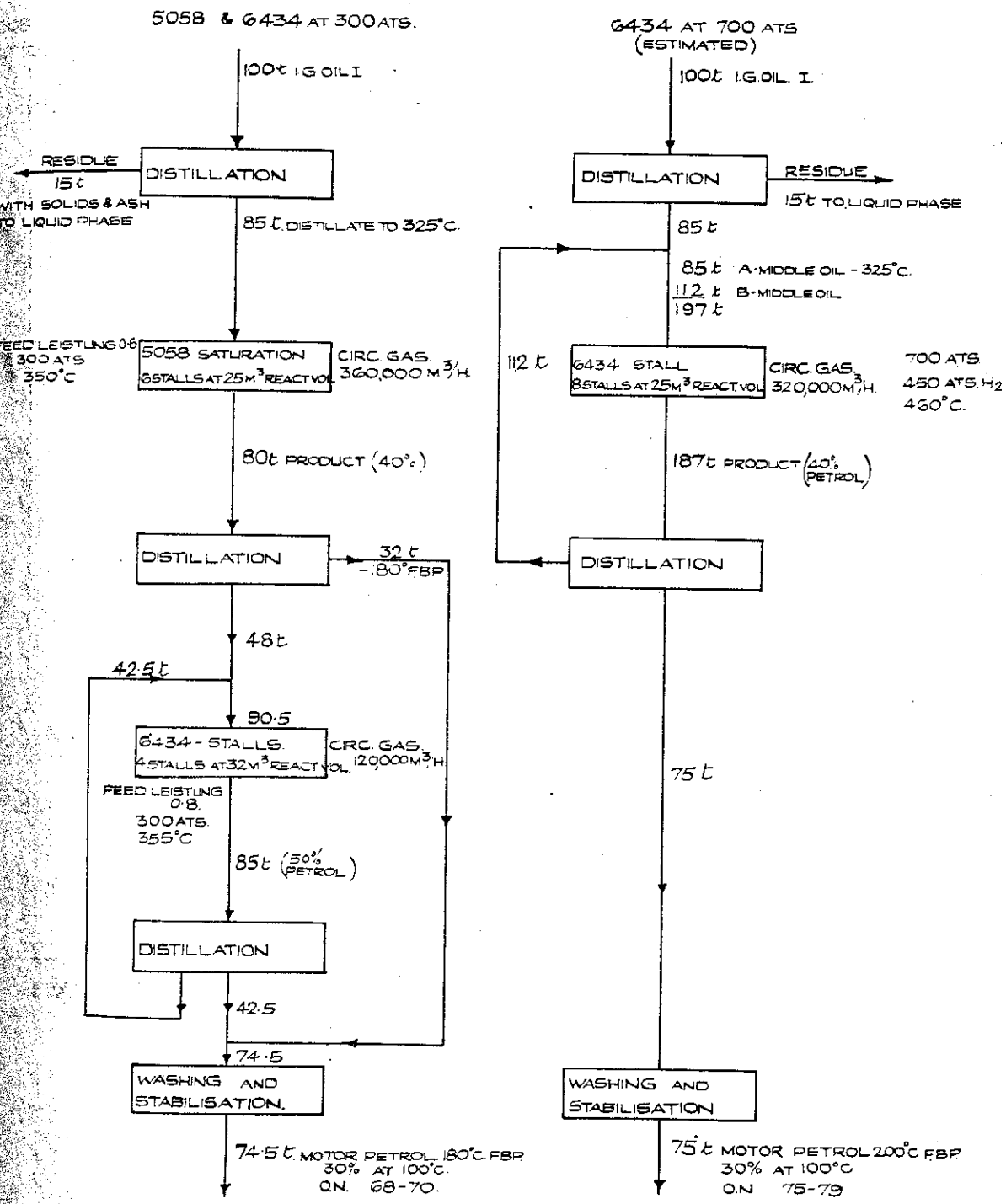

FIG VII. COMPARATIVE FLOWSHEETS FOR PETROL FROM BITUMINOUS COAL TAR MIDDLE OIL

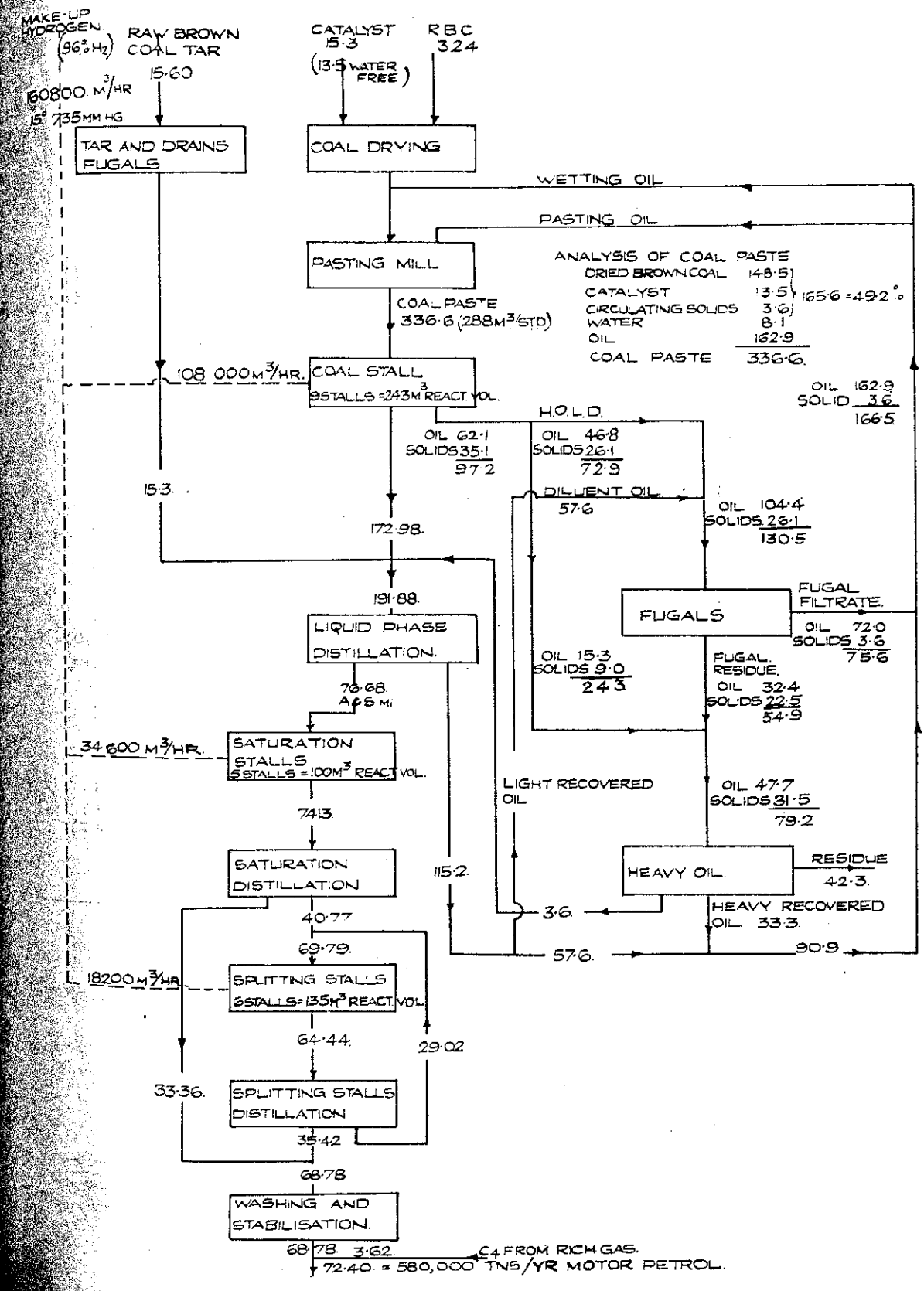

FIG. VIII FLOWSHEET FOR MOTOR PETROL FROM BROWN COAL BY HYDROGENATION

ALL QUANTITIES IN TNES/HR UNLESS STATED

ALL FLUID PRODUCTS ARE GAS FREE BUT INCLUDE C_5

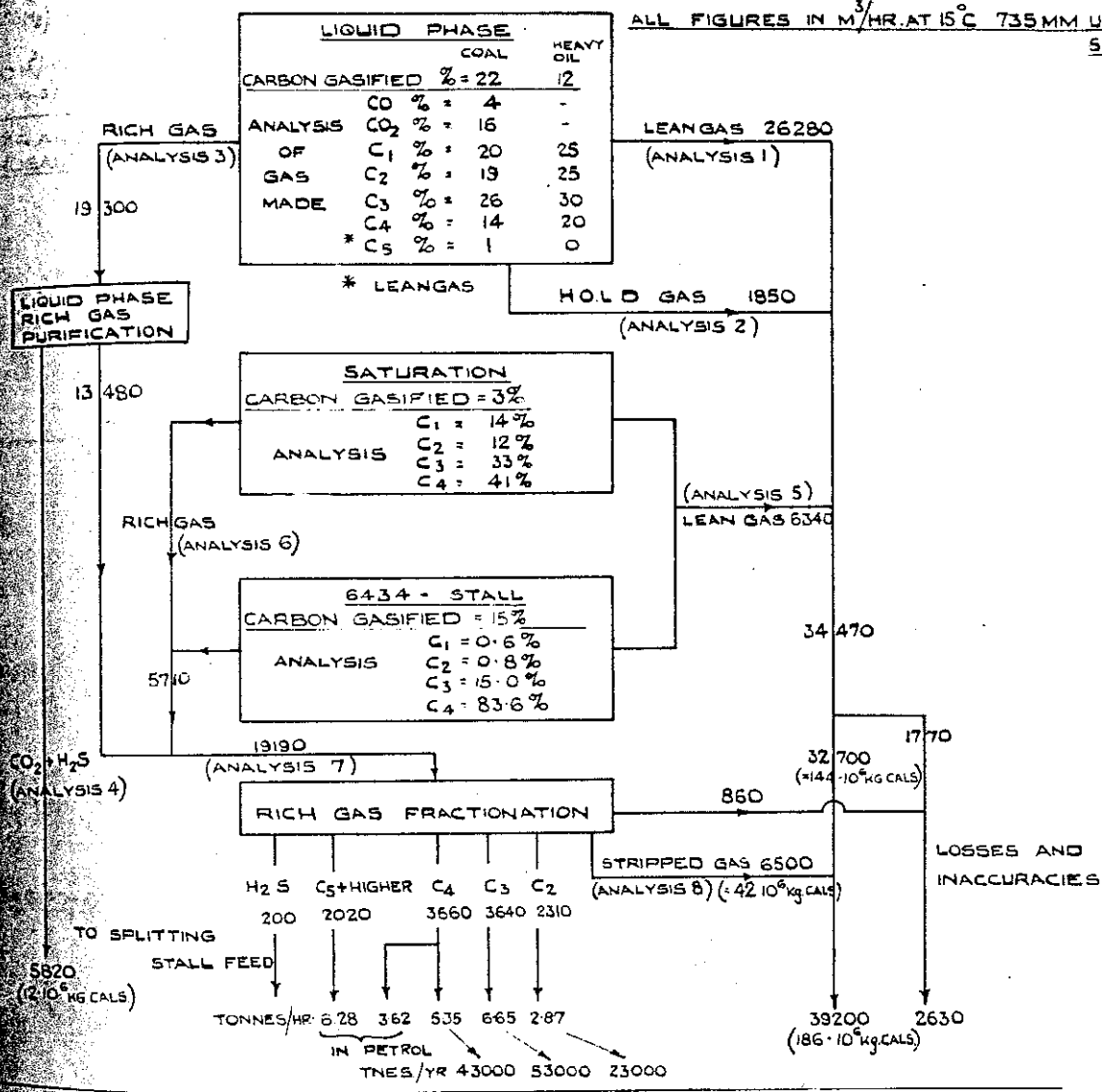

FIGURE IX

HYDROCARBON GAS FLOWSHEET MOTOR PETROL FROM BROWN COAL

ANALYSES (VOLUME %)

	1	2	3	4	5	6	7	8
H_2 %	42·1	26·8	5·7	-	67·0	6·8	7·8	21·9
N_2 %	8·5	5·7	2·1	-	17·6	3·5	3·1	8·7
CO %	5·0	3·5	1·4	-	-	-	1·4	3·9
CO_2 %	10·7	13·8	18·2	60·1	-	-	-	-
H_2S %	1·8	6·1	12·0	39·9	0·6	3·6	1·1	-
C_1 %	25·3	21·9	17·2	-	14·9	8·3	19·7	55·5
C_2 %	4·3	8·7	14·7	-	1·3	3·5	15·9	8·9
C_3 %	2·0	7·9	16·0	-	2·2	14·6	20·3	1·1
C_4 %	0·3	3·2	7·1	-	2·0	43·3	20·1	-
C5 HIGHER %	0·1	2·4	5·6	-	0·4	16·4	10·6	-
HEATING VALUE KG.CALS/M³	4330	7240	11200	2070	3910	21400	17000	6460
DENSITY KG/M³	0·67	1·01	1·480	1·65	0·475	2·03	1·59	0·659

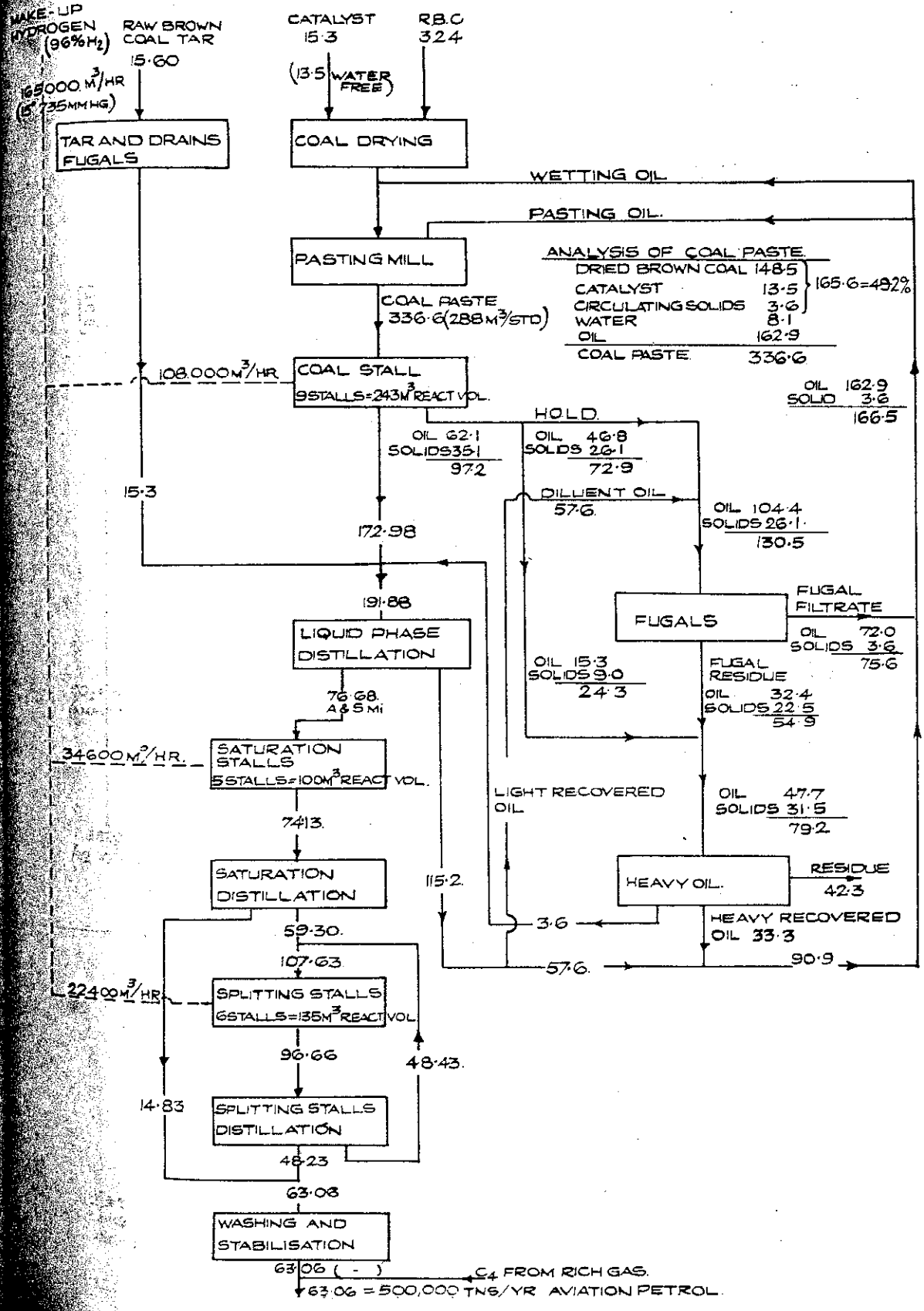

FIG. X FLOWSHEET FOR AVIATION PETROL FROM BROWN COAL BY HYDROGENATION

ALL QUANTITIES IN TNES/HR UNLESS STATED

ALL FLUID PRODUCTS ARE GAS FREE BUT INCLUDE C_5

ALL FIGURES IN M^3/HR. AT 15°C 735 MM. UNLESS STATED

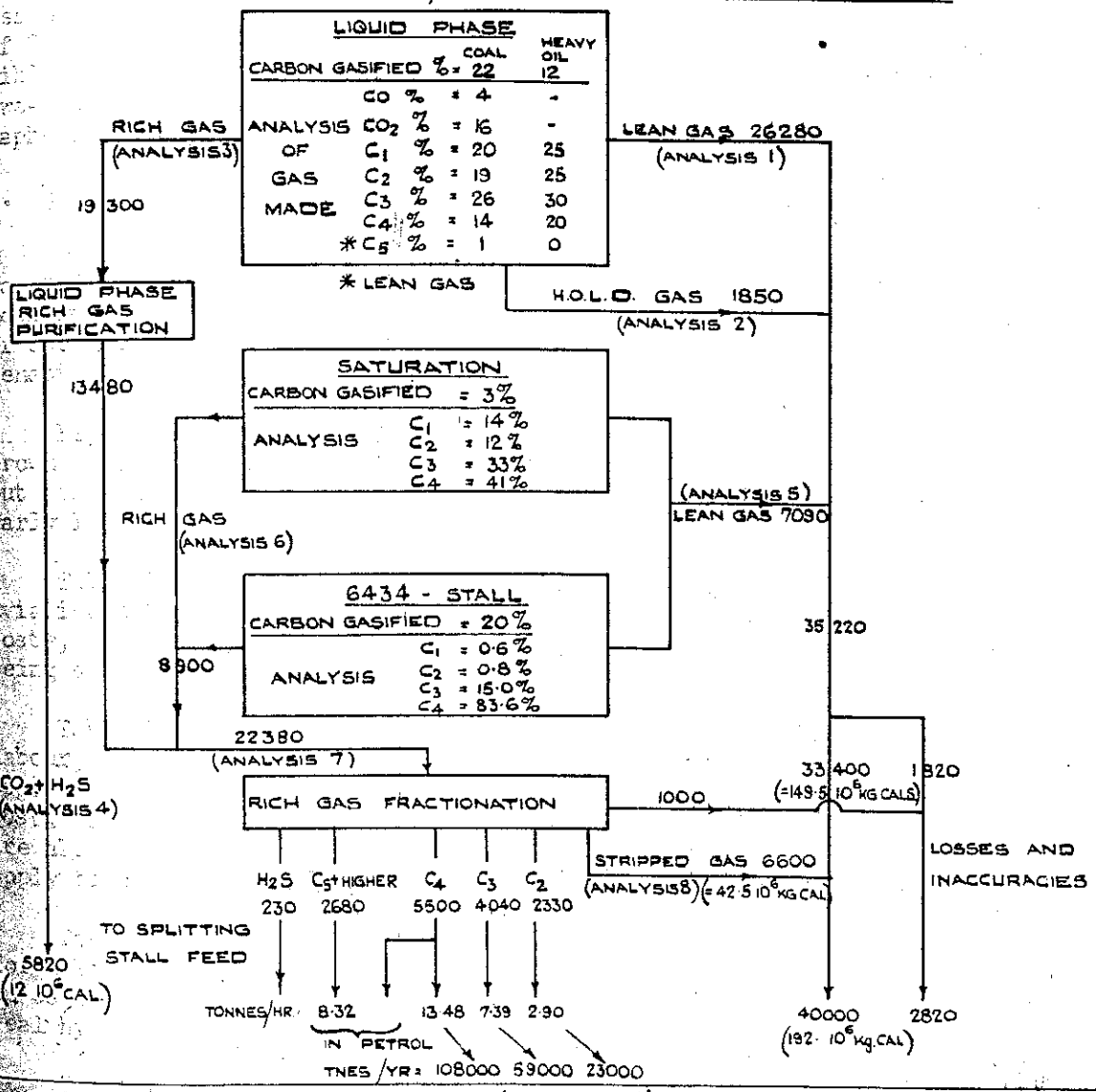

FIGURE XI

HYDROCARBON GAS FLOWSHEET AVIATION PETROL FROM BROWN COAL

ANALYSES (VOLUME %)

	1	2	3	4	5	6	7	8
H_2 %	42·1	26·8	5·7	-	60·0	4·8	6·9	22·1
N_2 %	8·5	5·7	2·1	-	77·0	2·4	2·7	8·8
CO %	5·0	3·5	1·4	-	-	-	1·2	3·8
CO_2 %	10·7	13·8	18·2	60·1	-	-	-	-
H_2S %	1·8	6·1	12·0	39·9	0·7	2·7	1·1	-
C_1 %	25·3	21·9	17·2	-	14·4	5·8	17·2	55·2
C_2 %	4·3	8·7	14·7	-	1·3	2·6	13·7	8·8
C_3 %	2·0	7·9	16·0	-	2·9	14·1	19·4	1·3
C_4 %	0·3	3·2	7·1	-	3·1	49·7	25·8	-
C_5+ HIGHER %	0·1	2·4	5·6	-	0·6	17·9	12·0	-
HEATING VALUE KG CALS/M^3	4330	7240	11200	2070	4390	23000	18300	6460
DENSITY KG./M^3	0·67	1·01	1·480	1·65	0·513	2·17	1·71	0·659

higher than is the case in the normal two stage 300 ats. process. If it is essential to produce petrol of high aromatic content and an octane number of 75-79, there is clearly an advantage in using the 700 ats. method (possibly with a less saturating catalyst than 6434) instead of the conventional two-stage method followed by D. H. D. treatment of the saturation stage naphtha.

F. Hydrogenation Costs

On the instructions of the Ministry of Fuel & Power a special effort was made to get detailed information on the economics of the hydrogenation activities at Leuna. During our visit, Dr. Pichler went through the whole of the available records and made the following summary of brown coal hydrogenation costs.

Figs. VIII to XI present the basic flowsheet data for hydrogenation of brown coal to motor and aviation petrols using the latest Leuna high-throughput conditions. They are typical of the Leuna operations during 1943 and early 1944.

Table I gives an analysis of the cost of production of motor and aviation petrols according to these flowsheets in terms of raw material costs, operating costs and capital charges, credits for hydrocarbon gases being taken into account.

Table II shows a breakdown of the operating costs in terms of operating labour, labour and materials for repairs, electric power, fuel gas, steam, etc. "Overhead charges" and obsolescence are shown as part of the operating cost. Labour is given in man/hours and consumptions of the various utilities are also quoted so that it is an easy matter to translate these costs to apply to British or American conditions.

Table III gives a still more detailed breakdown of operating costs for production of motor petrol by providing a detailed analysis of the costs in each section of the plant, e.g. coal drying, coal pasting, liquid phase coal hydrogenation, presaturation, splitting hydrogenation, etc.

Table IV shows the costs additional to those set out in Table III which are incurred when aviation base petrol is made.

These cost data will be analysed in a later report.

It is interesting to note that although the full cost of production of aviation base petrol was only 200 RM/Ton, the Leuna realisation was stated to have been 340 RM for this grade and 310 RM for motor gasoline. On the basis of these figures, the I. G. had a profit margin of about 80 x 10^6 RM/year in respect of Leuna hydrogenation activities alone. Dr. Pichler said that this very high return was allowed in order to compensate the I. G. for its heavy expenditure in developing the hydrogenation process.

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TABLE I. - COST CALCULATION FOR PRODUCTION OF PETROL FROM BROWN COAL

	Unit	Cost per Unit.RM	Motor Petrol Production				Aviation Petrol Production			
			Per hour		Per Tne Motor Spirit		Per hour		Per Tne Aviatn. Spirit	
			Quantity	RM	Quantity	RM	Quantity	RM	Quantity	RM
A. Materials										
1) Raw materials										
Brown Coal	Tne	3.00	324	972.00	4.475	13.43	324	972.00	5.138	15.41
Brown Coal Tar	"	80.00	15.60	1248.00	0.215	17.24	15.6	1248.00	0.247	19.79
2) Other Materials										
Make-up Gas (96% H_2)	M^3	0.042	160800	6753.60	2221	93.27	165000	6930.00	2617	109.90
Red Earth (dried)	Tne	20.00	15.3	306.00	0.211	4.23	15.3	306.00	0.243	4.85
Catalyst and other chemical				144.80		2.00		182.00		2.89
3) By-Products										
Butane x	Tne	170.14	5.35	1/910.25	0.074	1/12.57	13.48	1/2293.49	0.214	1/36.37
Propane x	"	170.14	6.65	1/1131.43	0.092	1/15.63	7.39	1/1257.33	0.117	1/19.94
Ethane	"	110.00	2.87	1/315.70	0.040	1/4.36	2.90	1/319.00	0.046	1/5.06
Hydrogenation Gas	10^3 T.Cals	7.00	198	1/1386.00	2.735	1/19.14	204	1/1428.00	3.235	1/22.65
B. Running Costs (See Table II)				6637.43		91.67		6916.89		109.69
Production Cost			72.40	12318.45	1.000	170.14	63.06	11257.07	1.000	178.51
C. Loading & Evaporation	Tne	3.00	72.40	217.20	1.000	3.00	63.06	189.18	1.000	3.00
D. On-Costs (I.C. direction, research, etc.				1220.66		16.86		1220.66		19.36
WORKS COST			72.40	13756.31	1.000	190.00	63.06	12666.91	1.000	200.87

x Valued at cost of production of Motor Petrol.

1/ Designates credit against operating costs.

TABLE II

BUILD UP OF RUNNING COSTS

	Motor Petrol Production per hour		Aviation Petrol Prodn. per hour	
	Quantity	RM	Quantity	RM
Labour Costs		677.62		695.75
Wages hrs.	447.51	524.65	459.01	538.47
Salaries		111.98		115.07
Social Insurance		40.99		42.21
Energy Costs		2,394.99		2,513.74
Water M^3	10,253.2	147.71	11,342.73	163.87
H. P. Steam Tne.	280.15	849.77	303.20	919.57
I. P. Steam Tne.	112.93	1/ 225.83	125.66	1/ 251.28
L. P. Steam Tne.	150.54	337.19	152.59	341.76
H.T.Electricity KW/hr.	15,460.47	317.86	16,451.88	332.85
L.T.Electricity KW/hr.	3,761.12	77.82	3,929.78	81.31
Fuel Gas 10^3 Tne Cals.	83,747.51	743.82	87,991.65	781.62
Brown Coal Tne.	45.063	139.46		139.46
Other Forms (Gas)		7.19		4.58
Repair Costs		1,496.85		1,561.71
Wages hrs.	371.97	451.61	383.60	465.56
Material		299.45		321.52
Workshop & Material oncost.		745.79		774.63
Working Material		57.63		59.35
Traffic Charges		154.53		154.90
Works General Charges		297.93		308.11
Capital Charges		1,139.34		1,190.10
Taxes		154.04		158.53
Various Costs		323.81		334.01
Credits		59.31		1/ 59.31
		6,637.43		6,916.89

1/ Designates credit against operating costs.

Remarks: 1. The supplementary charges are based on calculations made in Feb. 1943 for Motor Petrol or Aviation Petrol.

2. The rates for wage earners average 1 RM/hr. Owing to surcharges for holidays-with-pay, payment during illness, etc., the actual running cost rate averages 1.17 RM/hr. In peace time this surcharge was less. In the repair charges the payment for unworked hours has been included in the Workshops charges; the hourly rate of 1.20 RM/hr., therefore, is the actual rate of payment.

3. In a modern plant it is estimated that the Wages, Energy Requirements and Repair Charges would be 10-20% less.

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TABLE III. - BUILD-UP OF HYDROGENATION COSTS
(Based on values of Nov. 1943 and a Motor Fuel Production of 72.40 Tnes/hr)

	Coal-Steam Drying		Coal - Gas-fired drying		Paste Preparation		Paste Injection		Coal Stells		H.O.Lub. Fuels	
	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr
01. Wages		23.69		90.20		51.31		34.84		78.73		
Wages to IG workers. hrs.	12.73	15.42	48.40	60.96	27.42	33.42	22.92	27.32	51.33	61.87	12.38	
" " foreign " "	4.37	3.50	11.66	11.74	6.10	6.13	0.24	0.20	0:02	0.02	3.86	
Salaries		3.40		12.67		8.81		4.98		11.53		
Social Insurance, etc.		1.37		4.83		2.95		2.34		5.31		
02. Energy Costs		96.73		236.98		78.47		97.86		256.13		
L.P. Water (Take M^3	1.47	0.01										
L.P. Water (Cr. M^3												
H.P. Water "			0.47	0.01	6.66	0.10	238.93	3.53	1895.48	27.98	6.67	
Drinking Water "	0.93	0.09	2.52	0.24								
Cooling Water (Take "												
Cooling Water (Cr. "									1/302.64	1/10.14		
Condensate, Oil free "	1/35.82	1/9.29	1/0.34	1/0.09								
" Oily "					1/4.51	1/0.61	1/0.53	1/0.07	1/7.49	1/1.01	1/1.31	1/0.18
H.P. Steam. Tne	3.35	10.15	0.57	1.73	12.65	38.31			12.83	38.85	6.31	19.11
Back Pressure Steam "			1/0.35	1/0.69	1/3.89	1/7.78					1/3.11	1/6.22
L.P. Steam "	37.88	85.24	0.93	2.08	2.19	4.93	1.29	2.91	5.39	12.13		
H.T. Electricity KWH	20.20	0.30	2760.69	41.71	1222.19	18.46	5971.41	90.20	1112.28	16.80	185.65	2.8
L.T. ". Power "	137.25	2.84	471.76	9.76	443.90	9.19	56.56	1.17	42.28	0.87	68.89	1.43
" " Light "	8.81	0.18	32.28	0.67	11.20	0.23	5.87	0.12	2.04	0.04	2.33	0.05
Fuel Gas M^3			3385.25	30.06					19283.33	170.52		
Workshops Gas "											0.43	0.01
Nitrogen 90 lbs/in^2 "	263.89	4.30	45.25	0.74	866.53	14.13						
CO_2 7 lbs/in^2 "	3020.06	2.60	5686.36	4.90	1754.30	1.51			55.34	0.06	191.89	0.17
Towns Gas "												
Acetylene "												
Compressed Air "	90.65	0.31	1921.90	6.40					10.18	0.03		
Raw Brown Coal Kg			45062.94	139.46								
Bit. Coal and Coke "												
03. Repair Costs		27.86		95.86		173.79		37.93		346.81		38.22
Foreign Wrkrs. Wages. hrs.	0.63	1.04	6.88	8.96	0.45	0.55	0.07	0.07	0.59	0.64	0.92	1.85
" " Material & oncosts. hrs.		0.04		5.20		42.20		8.41		10.95		2.72
Stores Material		1.11		7.76		8.53		2.37		50.43		3.02
" " supplement		0.18		1.27		1.38		0.30		8.29		0.49
Workshops Wages. hrs.	8.73	10.73	24.38	29.79	38.12	46.09	8.25	10.09	82.82	99.98	9.74	11.65
Workshops Costs. s'ment		14.69		41.95		72.50		16.53		170.98		18.26
Repairs-Transport charges		0.07		0.93		2.54		0.07		5.54		0.27
04. Running Materials		0.65		3.27		11.32		0.66		1.33		1.40
Materials		0.59		2.86		11.00		0.57		1.31		1.24
Stores supplement		0.06		0.41		0.32		0.09		0.02		0.16
05. Traffic Costs		0.02		12.05		41.84		0.10		1.21		0.78
06. Works General Charges		9.28		35.06		22.21		14.14		37.16		9.26
Wage & Salary s'ment.		7.02		26.83		15.12		10.01		22.73		6.74
Fire Brigade		1.50		5.68		1.63		0.79		7.14		0.61
Post Office Costs		0.76		2.55		5.46		3.34		7.29		1.91
07. Capital Charges		20.60		145.83		68.17		15.49		168.21		23.29
Writing off		15.68		113.00		50.69		12.94		142.04		18.94
Interest		4.74		32.83		17.48		2.55		26.17		4.35
08. Taxes		4.93		21.18		11.98		6.40		17.79		4.76
09. Various Costs		2.14		59.23		8.68		0.37		24.39		7.59
Laboratory		2.02		20.71		7.70				23.84		7.17
Other Costs		0.12		0.68		0.98		0.37		0.55		0.42
Raw Material Stores				37.84								
Part cost Pipe Bridges												
" " Factory Wtr. System				43.76								
" " Tip Charges				4.43								
10. Credits												
Production: Total		185.90		747.85		467.67		207.79		931.76		125.25

1/ Designates credit against operating costs.

TABLE III. - BUILD-UP OF HYDROGENATION COSTS (Cont'd)
(Based on values of Nov. 1943 and a Motor Fuel Production of 72.40 Tnes/hr)

	H.C.L.D. Kilns		Tar Fugals		Liquid Phase Distillation		Gas Washing Plant		Circulation	
	Qty/hr	Rm/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr
01. Wages		77.89		24.38		21.65		23.31		20.89
Wages to IG workers. hrs.	43.75	51.53	13.34	15.94	12.35	14.83	12.60	14.88	11.69	13.93
" "foreign " "	14.83	15.31	3.19	3.28	0.80	0.92	1.03	0.99	1.92	1.83
Salaries		6.71		3.75		4.55	0.00[3]	6.02	0.00[2]	3.87
Social Insurance, etc.		4.34		1.41		1.35		1.42		1.26
02. Energy Costs		388.75		23.24		230.08		23.84		132.75
(Take M^3										
L.P. Water (Cr. "										
H.P. Water "	566.20	8.36	23.79	0.35	540.62	7.98	13.67	0.20	11.93	0.18
Drinking Water "	0.32	0.03			0.96	0.09				
Cooling Water (Take "										
(Cr. "										
Condensate - Oil free "										
" Oily "	1/14.26	1/1.93	1/2.92	1/0.40	1/1.81	1/0.25	1/0.17	1/0.02	1/12.17	1/1.64
H.P. Steam Tns	8.86	26.82	3.53	10.68	1.12	3.40	2.18	6.61	28.46	86.17
Back Pressure Steam "							1/1.96	1/3.92		
L.P. Steam "	25.79	58.03	3.59	8.08	8.64	19.44	0.20	0.45	1.05	2.37
H.T. Electricity KWH	180.34	2.72	3.21	0.07	1116.73	16.87	1330.07	20.08	2957.83	44.68
L.T. " Power "	67.61	1.40	198.20	4.10	118.69	2.46	10.87	0.23	45.65	0.94
" " Light "	0.71	0.01			0.47	0.01	2.02	0.04	2.63	0.05
Fuel Gas M^3	23431.90	208.10			19721.42	174.96				
Workships Gas "					6.90	0.16				
Nitrogen 90lbs/in^2 "					304.20	4.96	10.52	0.17		
CO_2 7 lbs/in^2 "	205.61	0.18	410.69	0.36						
Towns Gas "										
Acetylene "										
Compressed Air "	9.25	0.03								
Raw Brown Coal Kg.										
Bit. Coal & Coke "										
03. Repair Costs		143.23		21.60		62.80		50.94		55.90
Foreign workers wages, hrs.	0.73	1.35			2.32	3.80	0.20	0.37	0.01	0.01
" " material										
& oncosts.		6.80		0.56		6.00		3.04		5.02
Stores Material		14.12		1.71		1.44		5.32		6.43
" supplement		2.30		0.27		0.17		0.85		1.06
Workshops wages. hrs.	38.36	45.51	5.76	7.08	16.50	19.68	13.08	15.91	13.56	16.62
" costs supplement		71.22		11.62		30.94		25.90		26.58
Repairs - Transport charges		1.93		0.36		0.77		0.15		0.18
04. Running Materials		4.46		0.85		1.17		0.85		3.45
Materials		3.96		0.76		1.05		0.74		2.97
Stores supplement		0.50		0.09		0.12		0.11		0.48
05. Traffic Costs		92.50		0.38		0.04		0.04		0.08
06. Works General Charges		36.01		0.08		10.16		10.02		9.94
Wage & Salary S'ment.		22.91		7.21		6.25		6.70		6.10
Fire Brigade		2.65		0.14		1.64		2.09		1.81
Post Office Costs		10.45		1.73		2.27		1.23		2.03
07. Capital Charges		115.99		3.52		48.21		57.78		45.44
Writing off		94.12		2.64		42.10		50.15		32.67
Interest		21.87		0.88		6.11		7.63		12.77
08. Taxes		16.84		4.55		4.97		5.46		5.93
09. Various Costs		10.84		26.10		9.02		1.33		0.28
Laboratory		3.69		3.29		0.91		1.31		
Other Costs		7.15		0.67		0.10		0.02		0.28
Raw Material Stores				22.14		8.01				
Part Cost Pipe Bridges										
" " Factory Wtr. System										
" " Tip Charges										
10. Credits										
Production: Total:		801.51		113.70		388.10		173.57		274.66

1. Designates credit against operating costs.

TABLE III. - BUILD-UP OF HYDROGENATION COSTS (Cont'd)
(Based on values of Nov. 1943 and a Motor Fuel Production of 72.40 Tnes/hr)

	Vapour Phase Injection		Vapour Phase Stalls		Vapour Phase Distillation		Petrol Wash		Depropanising Plant	
	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr
01. Wages		21.70		48.72		27.96		2.61		9.13
Wages to IG workers, hrs.	13.82	16.52	30.70	37.08	16.22	19.75	1.69	1.98	7.05	8.47
" "foreign " "	0.14	0.12	0.01	0.01	0.45	0.44				
Salaries	0.00[2]	3.63	0.004	8.40	0.00[2]	5.98		0.46		
Social Insurance, etc.		1.43		3.23		1.79		0.17		0.66
02. Energy Costs		33.50		83.87		176.00		11.42		24.40
L.P. Water (Take M³										
" (Cr. "										
H.P. Water "			1817.18	26.83	529.40	7.82	126.75	1.87	32.34	0.48
Drinking Water "					3.93	0.37				
Cooling Water (Take "										
" (Cr. "			1/293.77	1/6.85						
Condensate, Oil free "										
" Oily "	1/6.87	1/0.12	1/0.21	1/6.03	1/1.80	1/6.24	1/1.71	1/6.23	1/3.02	1/0.41
H.P. Steam Tne	21.20	64.19	0.51	1.55	2.85	8.62			7.36	22.29
Back Pressure Steam "	1/19.07	1/38.13								
L.P. Steam "					7.31	16.45	4.15	9.34		
H.T. Electricity KWH	488.27	7.38	1784.68	26.96	570.90	8.62				
L.T. " Power "			40.83	0.84	490.26	10.15	17.64	0.36	98.00	2.03
" " Light "	5.55	0.11	1.96	0.04	5.68	0.12	3.92	0.08	0.39	0.01
Fuel Gas M³			4244.73	37.39	13598.41	120.77				
Workshops Gas "			3.76	0.09	54.03	1.28				
Nitrogen 90 lbs/in² "					12.23	0.20				
CO_2 7 lbs/in² "	80.58	0.07	21.85	0.02						
Towns Gas "										
Acetylene "										
Compressed Air "			9.77	0.03	554.19	1.84				
Raw Brown Coal Kg										
Bit. Coal & Coke "										
03. Repair Costs		36.98		214.99		28.24		6.97		20.53
Foreign workers wages. hrs.	0.22	0.29	0.25	0.26	0.21	0.26			0.21	0.22
" " material & oncosts		3.64		12.16		0.38		3.68		0.03
Stores material		4.95		64.97		1.29		0.17		1.42
" " supplement		0.83		10.88		0.22		0.03		0.21
Workshops wages hrs.	8.55	10.44	36.19	43.21	8.48	10.26	1.07	1.26	5.59	6.83
" costs supplement		16.61		82.19		15.07		1.83		10.64
Repairs - Transport charges		0.22		1.32		0.76				1.18
04. Running Materials		2.93		3.76		0.64				
Materials		2.52		3.39		0.55				
Stores supplement		0.41		0.37		0.09				
05. Traffic Costs		0.05		1.37		0.13				0.04
06. Works General Charges		10.79		28.77		13.07		0.99		2.90
Wage and salary s'ment.		6.37		14.03		8.04		0.75		2.68
Fire Brigade		0.96		8.50		2.15		0.09		0.22
Post Office costs		3.46		6.24		2.88		0.15		
07. Capital Charges		17.54		179.66		27.98		2.62		8.49
Writing Off		14.52		150.48		22.84		1.88		7.57
Interest		3.02		29.18		5.14		0.74		0.92
08. Taxes		4.33		13.13		6.90		0.65		1.69
09. Various Costs		0.28		39.34		2.58		0.88		0.22
Laboratory		0.02		27.34		2.21		0.88		0.01
Other Costs		0.26		1.09		0.37				0.21
Raw Material Stores				10.91						
Part Cost Pipe-Bridges										
" " Factory Wtr. System										
" " Tip Charges										
10. Credits						1/etc0.01				
Production: Total:		128.11		613.61		283.49		26.14		67.40

1/ Designates credit against operating costs.

TABLE III. - BUILD-UP OF HYDROGENATION COSTS (Cont'd)
(Based on values of Nov. 1943 and a Motor Fuel Production of 72.40 Tnes/hr)

	Liquid Phase Rich Gas Purification		Rich Gas Fractionation		Petrol Testing		Liquid Phase Intermediate Storage		Vapour Phase Intermediate Storage	
	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr
01. Wages		20.97		40.11		0.76		16.0		3.39
Wages to IG workers, hrs.	8.80	9.62	24.47	29.34			10.15	12.01	2.18	2.49
" "foreign " "	5.54	4.08	0.53	0.44						
Salaries	0.003	6.28	0.004	7.70		0.72	0.001	2.93		0.69
Social Insurance, etc.		0.99		2.63		0.04		1.06		0.21
02. Energy Costs		152.77		294.30		0.15		73.26		19.34
Low Pressure Water (Take M³	735.00	5.35								
" " (Cr. "	1/19.76	1/0.09								
High Pressure " "	67.21	0.99	3623.55	53.50	5.49	0.08	14.35	0.21	1.42	0.02
Drinking Water "	0.26	0.02								
Cooling Water (Take "										
" (Cr. "										
Condensate - Oil free "										
" - Oily "	1/1.75	1/0.24	1/17.49	1/2.36	1/0.01		1/9.41	1/1.27	1/2.61	1/0.35
High Pressure Steam "	42.74	130.87	99.78	302.17			14.46	43.79	5.44	16.47
Back " " "	1/36.94	1/73.87	1/47.04	1/94.08			1/0.57	1/1.13		
Low " " "	36.68	82.16	4.48	10.05	0.03	0.06	8.92	20.06	0.89	1.99
H.T. Electricity KWH			857.44	16.10			219.20	3.31		
H.T. " Power "	357.77	7.41	419.15	8.67	0.30	0.01	335.51	6.94	57.05	1.19
" " Light "	1.16	0.02	4.21	0.09	0.04		0.35	0.01		
Fuel Gas M³										
Workshops Gas "										
Nitrogen 90 lbs/in² "	5.08	0.08					82.42	1.34		
CO_2 7 lbs/in² "	57.47	0.05								
Towns Gas "										
Acetylene "										
Compressed Air "	6.94	0.02	62.19	0.20					6.87	0.02
Raw Brown Coal Kg										
Bit. Coal & Coke "										
03. Repair Costs		37.63		42.31		3.31		23.40		6.64
Foreign Workers wages, hrs.	0.30	0.42	0.31	0.31			0.26	0.26		
" " material & oncosts		0.76		0.35		0.01		2.84		
Stores Material		3.46		2.87		0.01		1/0.46		0.28
" " supplement		0.74		0.76				1/0.08		0.05
Workshops Wages. hrs.	10.53	12.47	12.04	14.40	1.03	1.27	6.91	8.19	2.00	2.49
" Costs supplement		19.76		23.26		2.02		12.54		3.81
Repairs - Transport charges		0.02		0.36				0.11		0.01
04. Running Materials		1.04		1.46		1.00		0.39		0.01
Materials		1.03		1.45		1.00		0.33		0.01
Stores supplement		0.01		0.01				0.06		
05. Traffic Costs		0.61		2.98		0.04		0.12		
06. Works General Charges		8.62		16.59		0.23		6.66		1.46
Wage & Salary s'ment		7.41		13.14		0.20		4.60		0.98
Fire Brigade		1.00		2.34		0.02		0.87		0.48
Post Office Costs		0.21		1.11		0.01		1.19		
07. Capital Charges		42.34		101.92		0.63		20.88		4.67
Writing off		32.59		78.30		0.49		17.51		3.92
Interest		9.75		23.62		0.14		3.37		0.75
08. Taxes		4.71		9.88		0.17		3.36		0.73
09. Various Costs		7.82		7.10		1/0.02		1.70		0.38
Laboratory		7.25		6.22				1.37		0.88
Other Costs		0.16		0.79		1/0.02		0.33		
Raw Material Stores		0.41		0.09						
Part cost Pipe-Bridges		5.89						6.46		4.31
" " Factory Wts. System		3.82								
" " Tip charges										
10. Credits	Transferred to 5058 Catalyst Plant H.S. gas section			1/2.47						
Production: Total:		286.22		524.18		6.27		152.23		41.43

1/ Designates credit against operating costs.

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TABLE III. - BUILD-UP OF HYDROGENATION COSTS (Cont'd)
(Based on values of Nov. 1943 and a Motor Fuel Production of 72.40 Tnes/hr)

	Hydrogenation Drain Wtr. Treatment		Hydrogenation Phenol Separation		Hydrogenation Phenol Washing		Total	
	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr
01. Wages		3.39		2.02		11.28		677.62
Wages to IG workers, hrs.	0.21	0.28	1.11	1.15	6.00	7.23	391.21	470.54
" "foreign " "	1.61	1.55					56.30	54.11
Salaries		1.47		0.74		3.33		111.98
Social Insurance, etc.		0.09		0.13		0.70		40.99
02. Energy Costs		3.54		6.15		19.20		2394.99
Low Pressure Water (Take M³					356.64	2.60	1093.11	7.96
" (Cr. "					1/351.33	1/1.60	1/371.09	1/1.69
High Pressure Water "							9522.11	140.59
Drinking Water "					0.15	0.01	9.07	0.85
Cooling Water (Take "			2.66	0.10			2.66	0.10
" (Cr. "							1/596.41	1/19.99
Condensate - Oil free "					1/3.82	1/1.11	1/39.98	1/10.49
" - Oily "	1/0.23	1/0.03					1/84.28	1/11.39
High Pressure Steam Tne	0.37	1.13			5.58	16.90	280.15	849.77
Back " " "							1/112.93	1/225.83
Low " " "	0.41	0.09	0.58	1.30	0.14	0.03	150.54	337.19
H.T. Electricity KWH			53.11	0.80			1540.47	317.86
L.T. " Power "	113.67	2.35	0.46	0.01	75.10	1.55	3667.38	75.90
" " Light "			1.17	0.02	0.95	0.02	93.74	1.92
Fuel Gas M³							83685.04	741.80
Workshops Gas "							65.72	1.54
Nitrogen 90 lbs/in² "					43.50	0.71	2633.62	26.63
CO_2 7 lbs/in² "			3240.38	2.79	10.53	0.01	14735.06	12.72
Towns Gas "			16.48	0.47	0.27	0.01	16.75	0.48
Acetylene "								
Compressed Air "			196.89	0.66	22.21	0.07	2881.04	9.61
Raw Brown Coal Kg							45062.94	139.46
Bit. Coal & Coke "								
03. Repair Costs		7.18		1.31		12.42		1496.85
Foreign Workers Wages, hrs.	0.17	0.18					14.73	20.82
" " material & oncosts		0.86		0.08		0.53		116.26
Stores material		0.95		0.06		0.98		188.19
" " supplement		0.15		0.01		0.15		30.60
Workshops Wages hrs.	1.62	2.00	0.41	0.49	3.52	4.37	357.24	430.79
" Costs supplement		3.04		0.67		6.30		698.31
Repairs + Transport Charges						0.09		16.82
04. Running Materials		0.25		0.70		16.04		57.63
Materials		0.22		0.68		15.96		54.19
Stores supplement		0.03		0.02		0.08		3.44
05. Traffic Costs						0.24		154.53
06. Works General Charges		1.34		0.77		3.42		297.93
Wage & Salary supplement		1.03		0.77		3.20		200.62
Fire Brigade		0.27		0.20		0.19		42.97
Post Office Costs		0.04				0.03		54.34
07. Capital Charges		10.25		4.63		5.20		1139.34
Writing off		7.94		3.83		4.08		921.10
Interest		2.31		0.80		1.12		218.24
08. Taxes		1.01		0.48		2.21		154.04
09. Various Costs		7.72				0.32		228.86
Laboratory		7.38				0.04		134.24
Other Costs		0.34						14.87
Raw Material Stores						0.35		79.75
Part cost Pipe-Bridges								16.66
" " Factory Wtr. System		26.28						73.86
" " Tip charges								4.43
10. Credits			For H_2S make Tne Cal. 1/7.04			For Creosote Oil "S" Kg 1/49.79		1/59.31
Production: Total		60.96		9.02		20.61		6637.43

1/ Designates credit against operating costs.

TABLE IV.- EXTRA CHARGES FOR AVIATION PETROL.

	Circulation		Vapour Phase Injection		Vapour Phase Stalls		Vapour Phase Distillation		Rich Gas Fractionation		Total	
	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr	Qty/hr	RM/hr
01. Wages				5.59		12.54						18.13
Wages to IG workers. hrs.			3.56	4.25	7.90	9.54					11.46	13.79
" " foreign " "			0.04	0.03							0.04	0.03
Salaries				0.93		2.16						3.09
Social Insurance, etc.				0.38		0.84						1.22
02. Energy Costs		10.23		8.62		21.59		40.62		37.69		118.75
L.P. Water (Take M³												
(Cr. "												
H.P. Water "	0.92	0.01			467.74	6.91	122.17	1.80	497.79	7.35	1088.62	16.07
Drinking Water "							0.91	0.09			0.91	0.09
Cooling Water (Take "												
(Cr. "					1/75.62	1/2.53					1/75.62	1/2.53
Condensate, Oil free "												
" Oily "	1/0.94	1/0.13	1/0.22	1/0.03	1/0.05	1/0.01	1/0.42	1/0.06	1/2.91	1/0.39	1/4.54	1/0.62
H.P. Steam Tns	2.19	6.65	5.46	16.51	0.13	0.40	0.66	1.99	14.61	44.25	23.05	69.80
Back Pressure Steam "			1/4.91	1/9.81					1/7.82	1/15.64	1/12.73	1/25.45
L.P. Steam "	0.08	0.18					1.69	3.80	0.28	0.59	2.05	4.57
H.T. Electricity KWH	227.82	3.45	125.68	1.90	459.38	6.94	131.75	1.99	46.78	0.71	991.41	14.99
L.T. " Power "	3.52	0.07			30.51	0.22	113.14	2.34	37.55	0.78	164.72	3.41
" " Light "			1.43	0.03	0.50	0.01	1.31	0.03	0.70	0.01	3.94	0.08
Fuel Gas M³					1092.59	9.62	3138.11	27.86			4230.70	37.48
Workshops Gas "					0.97	0.02	12.47	0.30			13.44	0.32
Nitrogen 90 lbs/in² "							2.82	0.05			2.82	0.05
CO_2 7 lbs/in² "			20.74	0.02							20.74	0.02
Towns Gas "												
Acetylene "												
Compressed Air "					2.51	0.01	127.89	0.43	10.34	0.03	140.74	0.47
Raw Brown Coal ...Kg												
Bit. Coal & Coke "												
03. Repair Costs				9.52		55.34						64.86
Foreign Workers Wages. hrs.			0.06	0.07	0.06	0.07					0.12	0.14
" " Material				0.94		3.13						4.07
& oncosts. hrs.				1.28		16.72						18.00
Stores material				0.20		2.80						3.00
" " supplement												
Workshops Wages. hrs.			2.20	2.69	9.31	11.12					11.51	13.81
Workshops Costs Supplement				4.28		21.16						25.44
Repairs-Transport charges				0.06		0.34						0.40
04. Running Materials				0.75		0.97						1.72
Materials				0.65		0.87						1.52
Stores supplement				0.10		0.10						0.20
05. Traffic Costs				0.02		0.35						0.37
06. Works General Charges				2.78		7.40						10.18
Wages & Salary supplement				1.64		3.61						5.25
Fire Brigade				0.25		2.19						2.44
Post Office Costs				0.89		1.60						2.49
07. Capital Charges				4.52		46.24						50.76
Writing off				3.74		38.73						42.47
Interest				0.78		7.51						8.29
08. Taxes				1.11		3.38						4.49
09. Various Costs				0.07		10.13						10.20
Laboratory						7.04						7.04
Other Costs				0.07		0.28						0.35
Raw Material Stores						2.81						2.81
Part cost Pipe-Bridges												
" " Factory Water system												
" " Tip charges												
10. Credits												
Production: Total		10.23		32.98		157.94		40.62		37.69		279.46

1/ Designates credit against operating costs.