VI. DISTILLATION UNIT A.

(a) The A distillation unit consists of two (2) separate columns and equipment. In this unit the total coal hydrogenation product and outside oil for pasting are separated into the A-middle oil for the gas phase hydrogenation step and a heavy oil to be used again in the sump phase. (Fig. 23). Both the product and pasting oil are mixed together, as only one storage tank exists for A distillation feed.

(b) The main tower is equipped with packed sections, four (4) meters apart. The feed is preheated under fifty (50) atmospheres pressure, thereby keeping it in liquid phase. This prevents erosion and clogging of the packing through too high vapor velocity. Two (2) pump stages are used. By the first the feed is pumped at atmospheric pressure over a heat exchanger into an intermediate storage tank, while the second pumps the feed through the pipe still into the tower. The gas resulting from this preheating is condensed and used as explained later. All pumps are centrifugal.

(c) The feed may not contain more than one (1) percent water, otherwise it will cause foaming with a resulting flooding of the tower. The water removal is accomplished by settling in two (2) storage tanks. In order to obtain a complete dehydration, sufficient gas condensate is added to the feed to keep its specific

VI. DISTILLATION UNIT A. (Cont'd.)

gravity under 0.970 at fifty (50) degrees centigrade. This normally amounts to fifteen (15) percent of the feed.

(d) The middle oil for the gas phase must have an end point of three hundred fifty (350) degrees centigrade. This high boiling range material causes a heavy loading of the gas phase catalyst. Hence material boiling above three hundred fifty (350) degrees centigrade must be absolutely avoided. The distillation requirement therefore produces a gap between the end point (Engler) of the middle oil and the initial boiling point of the heavy pasting oil. This gap has to be paid for by burning extra heating gas in the preheater and using extra stripping steam in the base of the column. Hence the utility requirements, originally anticipated, are somewhat over the guaranteed figures.

(e) The unit started up without difficulty and has run well ever since. Water entrainment caused some trouble due to the emusifying effect of hydrogenation mud and paste. This was remedied by improving the sump phase operation and by blending tower feed with outside pasting oil.

(f) The tower can be operated with good separation and ordinary utility requirements at between thirty (30) and one hundred fifty (150) percent of the guaranteed capacity figures.

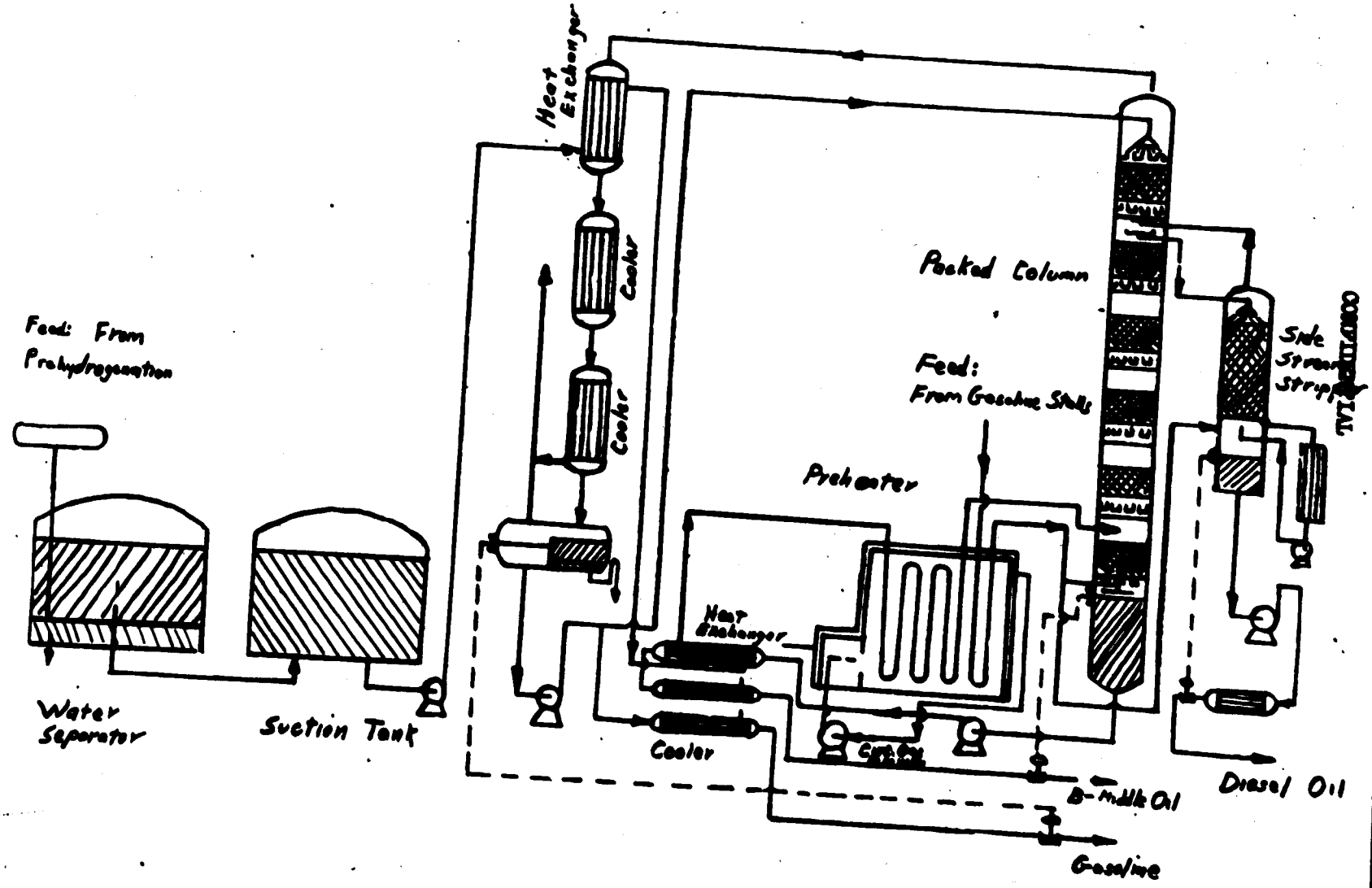
OPERATING RESULTS

Avg. operating capacity	85.6
"Number" of units used	1.715
Avg. unit capacity (including circulation)	48.6 tons/hr

OPERATION WITHOUT GAS CONDENSATE

A*middle oil	40.05 %
Residue (bottoms)	59.32 %
Overhead gas K	0.58 %
Loss	0.05 %
Middle oil end point	342.0 °C
Residue - I.B.P.	349.0 °C
Gap	7.0 °C

FIG. 24
B-Distillation



VI. DISTILLATION UNIT A. (Cont'd.)

OPERATION WITHOUT GAS CONDENSATE (Cont'd.)

Circulation quantity/total throughput	14.6 %
Distillation factor - without circ.	2.92 %
Distillation factor - with circ.	2.50 %

HOURLY QUANTITIES

Throughput (no recirculation)	71.3 tons/hr
A-middle oil	28.5 tons/hr
Residue	42.3 tons/hr
Tail gas	27.8 cu.met/hr
Gas condensate - returned	5.92 cu.met/hr

ENERGY REQUIREMENTS

Heating gas/ton throughput	0.125 mill kg, cal.
Steam/ton throughput	0.078 mill kg, cal.

VII. DISTILLATION UNIT B.

(a) In the B-distillation unit, the products from the gasoline stalls are separated. The apparatus greatly resembles that of the A-distillation. The tower packing is higher because a side stream stripper is connected to the column for removing intermediate products (Fig.24).

(b) The products of prehydrogenation and the gasoline stalls are separated by distillation. To produce the normal products of aviation gasoline and diesel oil, the following conditions are used. The effluent from the prehydrogenation step is cut at one hundred twenty-five (125) to one hundred thirty (130) degrees centigrade. If a part of the distillation residue is to be sold as diesel fuel, an intermediate fraction of from one hundred thirty-five (135) to two hundred five (205) degrees is withdrawn. The part boiling above two hundred five (205) degrees is diesel oil. The intermediate cut plus some diesel oil is then fed to the gasoline stalls. In using the whole distillation residue from the gasoline stalls, the yields of intermediate product is assured. The gasoline stall effluent is separated into

VII. DISTILLATION UNIT B. (b)(Cont'd.)

gasoline with an end point of one hundred fifty (150) degrees centigrade and a bottoms product which after mixing with the pre-hydrogenation residue is reused as feed to the gasoline stalls. The gasolines from both distillations are treated, and then blended with the condensed cut from C_4 unit followed by a caustic wash and stabilization.

OPERATING RESULTS

PREHYDROGENATION DISTILLATION - 5058

Stream efficiency	81.8 %
No. of operating units	0.83 %
Avg. load/unit (including circulation)	37.3 tons/hr

Yields

Gasoline 5058	31.7 %
Heavy gasoline 5058	2.28 %
B-middle oil 5058	64.66 %
Distillation gas 5058	1.27 %
Losses	0.09 %
F.B.P. - gasoline	150°C
I.B.P. - Heavy gasoline	136°C
F.B.P. - heavy gasoline	192°C
I.B.P. - B-middle oil 5058	155°C
Recycle product/total throughput	10.3
Distillations factor without recycle	3.26
Distillations factor with recycle	3.63

Hourly Quantities

Throughput without recycle	
Gasoline 5058	26.73 tons/hr
Heavy gasoline	8.21 tons/hr
B-middle oil 5058	0.61
Distillation gas	17.55
	180.0 cu.met/hr

VII. DISTILLATION UNIT B. (Cont'd.)

Utility Requirements

Heating gas/ton throughput	0.190 mill kg. cal.
Steam/ton throughput	0.139 ton

6434 - DISTILLATION

Stream efficiency	79.3 %
No. of operating units	0.55
Avg. load/unit (including circulating)	29.0 tons/hr

Yields

Gasoline 6434	48.08 %
B-middle oil 6434	49.57
Distillation gas 6434	2.35
Losses	0.00
F.B.P. gasoline	149°C
I.B.P. middle oil	152°C
Gap	3°C
Circulating product/total throughput	8.33 tons/hr
Distillation factor (throughput - distillation)	
With recycle	2.27
Without recycle	2.08

Hourly Quantities

Throughput without recycle	15.99 tons/hr
Gasoline 6434	7.69 tons/hr
B-middle oil 6434	7.92
Distillation gas	162.0 cu.met/hr

Utility Requirements

Heating gas/to throughput	0.163 mill kg. cal.
Steam/ton throughput	0.038 ton

VIII. ALKALINE WASH AND STABILIZATION.

(a) The crude gasoline is purified by an alkaline wash using dilute NaOH solution to remove H_2S and Phenolics. This is followed by treatment in the stabilizer to remove the light hydrocarbons and make the vapor pressure correct for a saleable product.

(b) Apparatus. (Fig. 25)

The alkaline wash precedes the stabilizer in order to protect it from H_2S corrosion. A degasser may be installed ahead of the alkaline wash. The alkaline wash is done in two (2) stages. For washing entrained alkaline solution, a water wash is employed afterwards. The stabilizer is made with a round-based column, and is built for six (6) atmospheres working pressure. It operates fully automatic except for manual feed injection.

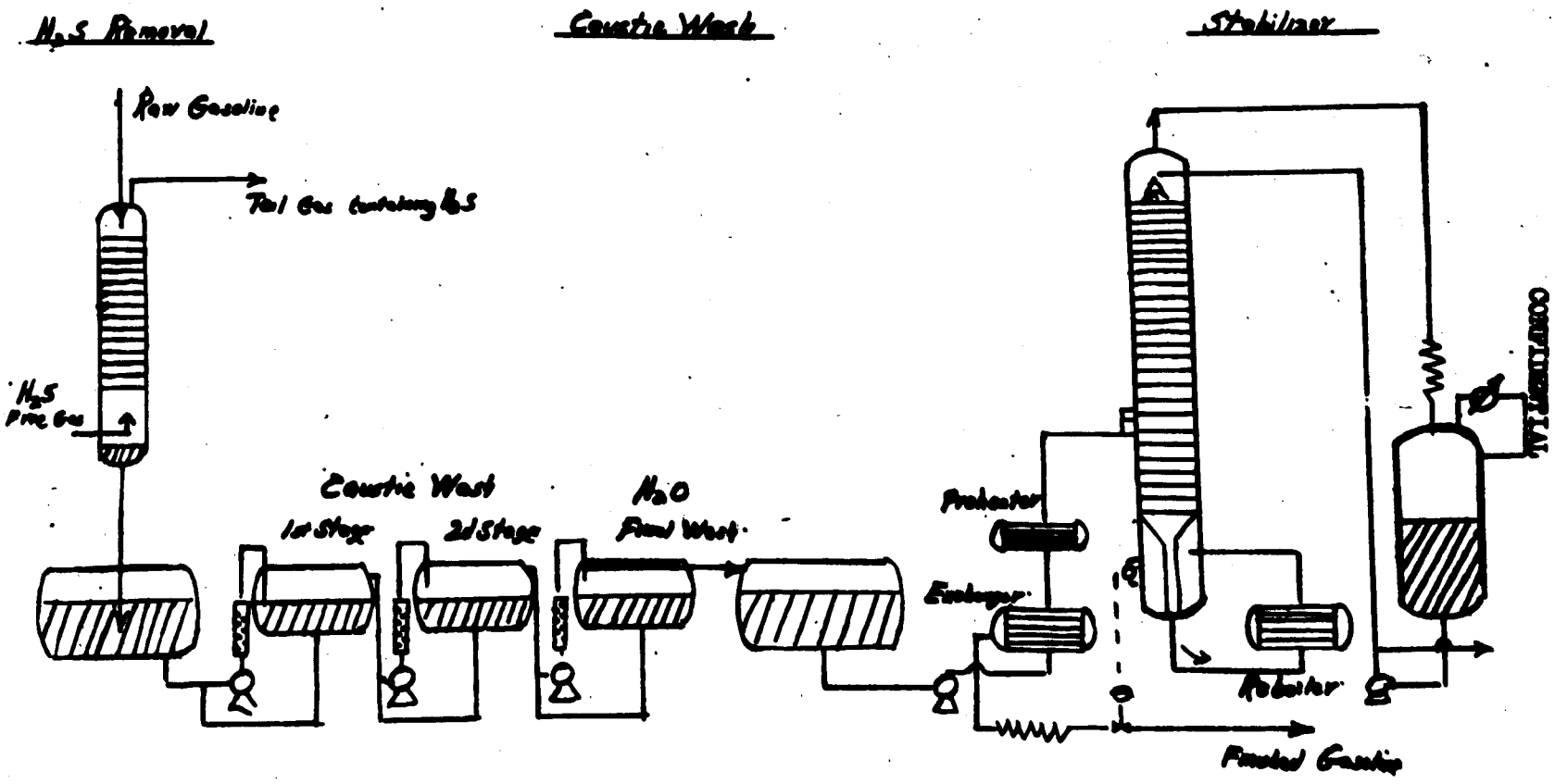
(c) Operation.

Since the crude gasoline contained only one hundred fifty (150) to two hundred (200) milligrams H_2S/liter, degassing was unnecessary. The gasoline was generally stabilized to have a vapor pressure of 0.5 atmospheres by the removal of dissolved C_1 to C_4. The resulting liquid heads product was vaporized and combined with the heads gas from the C_3 plant. With increased production the C_3-C_4 plant was not able to meet its guarantee, and the C_3 head product could not be used as mentioned. Consequently the reflux to the stabilizer had to be increased which was able to maintain the purity specifications for marketable C_3 gas. Thus the C_3 plant was kept supplied. The fraction of the total C_3 production resulting from C_3 heads gas amounted to about thirty (30) percent.

OPERATING CONDITIONS

Gasoline	21.5 ton/hr
Vapor pressure at entrance of stabilizer	0.95 atm.
Vapor pressure at exit of stabilizer	0.48 atm.
Liquid top product	1.1 ton/hr

FIG. 25


H_2S Removal
Caustic Wash
Stabilizer
Raw Gasoline
Tail Gas containing H_2S
H_2S Free Gas
Caustic Wash
1st Stage
2d Stage
H_2O
Final Wash
Preheater
Exchanger
Reboiler
Finished Gasoline
CONDENSER

VIII. ALKALINE WASH AND STABILIZATION. (Cont'd.)

OPERATING CONDITIONS (Cont'd.)

Reflux ratio	1 - 8
Operating pressure	5 - 7
Head temperature	45 - 55°
Boiler temperature	150 - 165°
18 atm. steam consumption	0.18 ton/ton inlet against 0.15 ton/ton when based on outlet top C_3 gas

ANALYSIS OF LIQUID TOP PRODUCTS

	Mol %
C_2	nil
C_3	10.
iC_4	45.
nC_4	45.
C_5	nil

ANALYSIS OF HEAD GASES

C_1	2.0
C_2	8.0
C_3	28.0
iC_4	28.0
nC_4	25.0
C_5	8.0