1923

The construction, equipment and operation of the second largest oil refinery in Mexico

Arturo C. Fernandez

THE CONSTRUCTION,EQUIPMENT AND OPERATION OF THE SECOND LARGEST OIL REFINERY IN MEXICO.

By

ARTURO C. FERNANDEZ

A

THESIS

submitted to the faculty of the

SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI

in partial fulfillment of the work required for the

Degree Of

ENGINEER OF MINES

Monterrey, N. L.

Mexico.

1923.

Approved by ---------------------------------------
Professor of Mining.

PREFACE

In the preparation of this thesis the writer has endeavored to describe in a clear,concise and simple manner the general scheme carried out by the Foundation Company in the construction,equipment and operation of the Corona Refinery at Chijol,Veracruz,Mexico.

Under construction,the most interesting features of the work executed by the Field Engineering department have been discussed at some length. Throughout this paper elementary details have been omitted,the casual reader being assumed to possess a knowledge of the fundamental principles of engineering.

No attempt has been made to cover the activities of the allied--mechanical,electrical,architectural--departments of engineering as no single individual in the organization could hope to have the time nor the opportunity to become sufficiently acquainted with all their details of operation to describe them in a comprehensive manner.

The illustrations accompanying this paper have been carefully prepared and are intended as a suplement to the subject matter;it is hoped that they will be found helpful in making the text clear.

Monterrey,N.L. September 20,1923. A.G. Fernandez

CONTENTS.

PART I.

GENERAL INFORMATION.

PART II.

GENERAL CONSIDERATIONS.

PART III.

CONSTRUCTION.

PART IV.

MECHANICAL EQUIPMENT.

PART V.

OPERATION.

List of Illustrations.

PART I.

GENERAL INFORMATION.

LOCATION.- The oil refinery of the Corona Petroleum Company is situated on the southern bank of the Panuco River three and a quarter miles from the Gulf of Mexico on its terminal at Chijol,Municipality of Pueblo Viejo, Canton de Ozuluama,Estado de Veracruz,Mexico.

Further south on lots 28,29,37,38 lies the Buena Vista tank farm where the Corona Company keeps in storage ample reserves of crude oil pumped directly from the fielda.

CHIJOL AND VICINITY.- Chijol,but a few years ago,a tract of wild marsh land has been turned into a rich center of activity where capital and energy have combined to develop the largest oil field in the world. Mexican crude is especially suited for fuel oil purposes and large steamship tankers carry this oil to all parts of the world.

The city of Tampico lies on the Panuco River seven miles from the Gulf of Mexico,this river forming the dividing line between the states of Tamaulipas and Veracruz. Both above and below Tampico,on either side of the Panuco River are located the individual terminals of the various oil companies.

HISTORICAL SKETCH.- Tampico a few years ago was only a small gulf port containing but a few thousand native inhabitants. Pueblo Viejo,(Old Town) dates from the conquest of Cortez around the year 1519 and stands across the river from Tampico and still contains evidences of those historic days. Tampico was actually settled about the year 1823. Emerging from a small unimportant seaport Tampico has rapidly become one of the foremost commercial cities of the world.

CLIMATE.- The climate is subtropical with a temperature range of 45 degrees in the winter season to 97 in the summer. A temperature of 45 degrees however,is unusually cold and is experienced very few times during the winter. The gulf breeze tends to discount the summer heat and the nights are very confortable.

POPULATION.- Only 12 years ago the estimated population of Tampico was 18000 inhabitants. Today the population is estimated at over 125,000 people. Among these people will be found many Chinese,American,British,and Spanish subjects together with other nationalities in fewer numbers.

STATISTICAL NOTES.- The importance of the Mexican oil fields of which Tampico is the shipping center can be best estimated by the following figures giving the exports of crude,topped and refined oil for the years 1920 and 1921.

Year 1920 ------- 163,000,000 Bbl.

Year 1921 ------- 191,500,000 " .

PART II.

GENERAL CONSIDERATIONS.

AREA.- The refinery of the Corona Petroleum Company comprises an area of 62 Hectaras,81 Aras,90 square meters (equivalent to 155 acres approximately) and a water front along the Panuco River 815 meters long.

SOURCES OF PETROLEUM.- The crude oil comes directly from the wells which the company owns in the Topila and Panuco fields in three eight inch pipe lines. There are six intermediate or relay oil pump stations,the furthest one being 120 kilometers distant from the refinery.

OIL ANALYSIS.- Physical properties of Panuco Crude.

Specific gravity --------	0.978 - 20 C.
Flash Point -------------	72 - F.
Gasoline ----------------	2.2 per cent
Kerosine ----------------	16 " "
Gas oil -----------------	50 " "
Asphalt -----------------	31 " "

Topila Crude. -

Specific gravity --------	0.955 - 20 C.
Flash point -------------	95 - F.
Gasoline ----------------	1.65 percent
Kerosine ----------------	18.50 " "
Gas Oil -----------------	53.50 " "
Asphalt -----------------	26.00 " "

DESCRIPTION OF THE PLANT.- The refinery consists at present of A,B,C and D units. A and B units are identical in design,equipment and operation,A unit being left hand and B unit right hand. Each consists of one fractionating unit and two topping units.

A UNIT.- Fractionating Plant.

I.- Primary part.

(a)-Furnaces

(b)-Distil coils

(c)-Evaporators

(d)-Superheaters

2.- Secondary part

(a)-Dephlegmators

(b)-Separators

(c)-Coolers

(d)-Vertical condensers

(e)-Receiving house

(f)-Heat exchangers

Topping Plants.- Units 2 and 3

I.- Primary part

(a)-Furnaces

(b)-Distil coils

(c)-Evaporators

2.- Secondary part

(a)-Surge Tanks

(b)-Water separators

(c)-Condensers

C AND D UNITS.- Topping Plant.

I.- Primary part

(a)-Furnaces

(b)-Distil coils

(c)-Evaporators

(d)-Superheaters

2.- Secondary part

(a)-Dephlegmators

(b)-Condensers

(c)-Coolers

(d)-Receiving house

(e)-Heat exchangers

(f)-Rerun stills

(g)-Lubricating stills

(h)-Asphalt stills

(j)-Separators.

PART III.

CONSTRUCTION.

ORGANIZATION.- In an undertaking of the importance of the one under consideration involving the expenditure of millions of dollars,an efficient business management, good technical methods and a skilled technical staff are essential to the proper conduct of the work and the successful achievement of the enterprise. Ample funds were available for every justified expenditure,the aim being to construct an oil refinery,modern,efficient,economical in genoral layout,construction,equipment and operation disregarding the initial cost to obtain the largest returns for every dollar invested.

We will not engage ourselves in a lenghty discussion covering all the relations between the various departments of this organization;suffice it to say that all department heads were held responsible for the proper discharge of the work under their supervision,that all were united for a common aim : the smooth,even progress of the work,working in full accord and harmony and displaying a friendly spirit of mutual help,assistance and cooperation.

Illustration number 2 shows the details of our organization and the relations between the various departments.

FIELD ENGINEERING DEPARTMENT.

STAFF.- The staff of the Field Engineering Department consisted of I Chief Field Engineer,I assistant chief field engineer,4 field engineers,I office clerk and 9 rodmen.

EQUIPMENT.- This department was equipped with instruments and accessories of standard make and latest design. Since it serves no useful purpose to describe in detail the names and makes of the manufacturers I will confine myself to saying that the equipment was modern and complete in every detail;everything needed for the rapid discharge of its duties was provided for.

DUTIES.- The field engineering staff was,since the outset,held responsible for the accurate layout both as to center lines and grade of every single item entering into the make-up of the refinery.

In addition to giving center lines and grades for rail-road tracks,oil,water,steam,etc,pipe lines,roads, ditches,sewers,tank sites,cement and reiforced concrete structures,etc,etc,the field engineers acted as inspectors and ckecked all cement and reinforced concrete work to insure its being done according to rigid specifications.

The field engineers conducted also extensive tests on the bearing power of soils,supervised all pile foundation work completed important hydrographic surveys,and performed all other miscellaneous civil engineering duties required in a project of this nature.

INSTRUCTIONS TO ENGINEERS.- Field Engineering Dept.

I.- Absolute accuracy is essential. You are personally responsible for all work that you do.

2.- Checking must be thorough and complete. The Manager Holds the checker even more responsible than the one who laid out the work.

3.- Mark all stakes plainly and completely;your work counts for nothing if your stakes are missread.

4.- All references to Location must be marked in black or blue. All Elevation marks will be in red.

5.- In setting elevation stakes the Base Line will always be given. All concrete bench marks are at the Official Ground Line which is I foot below the Base Line.

6.- When new stakes are set on an old job be sure to remove the old stakes. Confussion to the Construction Department results when two sets of stakes are found on the same job.

7.- Field books will be neatly kept and complete. When a thing is checked,a change is made,or additional or new stakes set,a note of it will be made on same page,giving date and name of engineer.

8.- Watch your Rodman and Chainman. They easily missread the Tape. We cannot get experienced help so their instruction is up to you.

9.- Care must be taken of instruments. If you think one is out of adjustment report it at once.

INSTRUCTIONS TO RODMEN.- Field Engineering Dept.

1.- Be absolutely accurate in everything that you do. The tape, the rod, or the pencil, must be held exactly on the point, not an eighth or even a sixteenth of an inch off.

2.- Read your tape correctly. Be sure you understand the measurement then find it on the tape.

3.- Keep the tape level at all times. Use the same amount of pull on the tape each time and keep it straight and untwisted. Do not jerk the tape.

4.- Drive stakes straight and with their tops at about the same elevation; this will help keep the tape level.

5.- Always carry with you the following : nails, pencil and both black and red crayon. If you are with the transit also take tape, plumb-bob and stakes. If you are with the level, take level rod and stakes.

6.- Do not break tapes or other equipment. Carelessness in handling tapes is inexcusable.

7.- All equipment must be thoroughly cleaned and oiled before putting away each night.

8.- Extreme care must be exercised in handling instruments. Observe the following rules :

(a) - Don't place an instrument on your shoulder while inside of a house; you may strike something with it.

(b) - Don't carry an instrument on one shoulder and the rod on the other; they might bump together.

(c) - Loosen screw so that instrument is free to turn when carrying or when set-up inside the office. Then if it is struck it will turn instead of resisting the blow.

(d) - Never clamp screws too tightly;the threads are of brass and may be injured.

(e) - Do not fool with instruments;you will get them out of adjustement.

(f) - Do not get oil on lenses;it fogs them and cannot easily be removed.

SPECIFICATIONS FOR THE MIXING AND POURING OF CONCRETE.

FORMS.- All form work must be constructed true to line and grade,well braced and tied before starting to pour concrete. The forms must be reasonably tight so as to prevent the leakage of the fine material. Where the sub-foundations under sills or forms which rest directly on the ground,are bad,a foundation of not in excess of 3 inches of crushed rock well tamped into the earth may be used. It will be preferable to place a false bottom of scrap lumber under the form,and on this pour a thin layer of concrete,allowing same to set before making the main pour. Where the footings rest on piling,the first pour must not cover the piling.

REINFORCING.- The reinforcing should be carefully placed to the exact dimension shown in the drawings and securely wired and tied to hold same to its true position while placing the concrete. This is important.

CONCRETE.- The proportions are to be specific for each case. The materials must be of good quality and of sizes specified.

(a) - Rock - This must be clean and graded as to sizes and all must be retained upon a 3/8" screen and pass a 1 1/2" ring where used for reinforced concrete, for slabs,wall panels,girders and on small footings or other forms of light concrete. When placed in large footings or other forms of mass concrete,the size may be increased to material passing a 4 inch ring.

(b) - Sand - This must be clean,sharp and well graded,free from clay,vegetable matter or loam and all particles of the sand should pass a quarter inch ring.

MIXING AND PLACING.- The aggregates must be thoroughly mixed to a creamy consistency using just sufficient water to get a quaky mixture when discharged from the mixer. Do not use too much water. In placing the concrete care must be taken that it is not put into standing or running water,that it is well tamped and particularly that it is not allowed to separate in the forms,keeping the distribution of the rock and fines equal at all places. If concrete is of right consistency the fines willnot run away from the rock. Concrete should be well spaded as placed especially around all reinforcing steel.

INTERESTING DETAILS OF CIVIL ENGINEERING PRACTICE.

Preliminary Preparation Of Refinery Site.- It has been stated before under "General Information" that the Corona Terminal was originally a low lying tract of marsh land necessitating to be filled in in places to bring the whole area to the proper grade. This in itself was not a serious objection in as much as the water front on the Panuco River had to be sufficiently deepened to permit the loading of tankers on the wharves of the terminal.

The dredging of the Panuco River was done in four separate operations by skilled contractors who owned the requisite machines. As the material excavated was a mixture of mud,sand and fine shells easily mixed with water and pumped through pipes,a Suction Dredge was used,it being the best fitted for this work.

The excavating machinery consisted of a suction pipe provided at the end with revolving cutters to loosen the material so that it could be more easily drawn into the suction pipe. In operation the end of the suction pipe was lowered to the soft bottom and partly buried its nose in the material. The pump was then started and sucked a stream of water and mud through the suction pipe discharging it into the discharge pipe.

An iron box with screen bars set 2 inches apart,placed between the suction and discharge pipes caught all oversize material. When this box was packed tight with extraneous substances and the pumps could not function the box was opened and cleaned and the lid clamped tight again. The discharge pipe was extended to the shore and discharged at those points where land was to be filled in.

LOCATION SURVEY.- After a careful consideration of the general layout of the plant and the area of available ground the skeleton survey or controlling base lines was so established as to serve as a ready check to the most important work providing at the same time ample space for possible future expansions. Illustration 3 shows the general arrangement, gives the lenght of base lines and elevation of bench marks.

The monuments made of concrete with a finished cement surface were set one foot below the finished surface of the ground, being protected from traffic or construction disturbances by heavy wooden casings. Half inch iron bars inserted in the concrete were used for bench marks. For sights or transit set-ups a fine tack driven into a well seasoned hard wood stake inserted in the concrete were used. The number of the station and elevation of the bench mark were neatly painted on the surface. A square area 1 inch deep and 4 inches long of which the bench mark was the center was left unfilled to allow the free swing of the rod when giving sights.

BEARING PRESSURE OF SOIL.- As an accurate knowledge of the safe bearing power of the soil was essential to the correct design of all building foundations,a careful study of the nature of the soil was the first subject for consideration. This knowledge was obtained by an extensive series of experiments carried out in test pits by applying a concentrated load of known weight upon a limited area of the bearing soil and making daily readings of the supported load.

GENERAL LAYOUT OF REFINERY.- This is best shown graphycally and the gentle reader is referred to illustration number 5.

HYDROGRAPHIC SURVEYING.- A correct determination of the shape and area of bottom of the Panuco River to be dredged was required to make an accurate computation of the volume of material dredged and hydrographic surveying was resorted to,to obtain this information.

The method of procedure was as follows: Having previously established on shore triangulation points to controll the survey a party was arranged to include,1 Chief of party to direct the work in the boat,to see that the boat was kept on the ranges and to act as signalman ; a recorder to write down in his note book the depths as called off by the leadsman,the times of soundings and to make all other observations pertaining to the work. One leadsman to take the soundings and 2 transit men stationed on shore.

The boat was rowed along range lines,the leadsman taking soundings as frequently as he could handle the lead-line. As a rule every fifth sounding was located by angles taken simultaneously by the two instrument men on shore.

The signal was given by waving a flag for about 5 seconds,then holding it up for about 10 and dropping it suddenly at instant the sounding was taken,at which time the transit men on shore read angles to the pole. Both the recorders and the instrument men's notes reported the time of each located sounding thus affording a check in identifying angles with their corresponding soundings.

To make use of the data thus obtained in the following computation work,the points that were located by transit were plotted on map and the intermediate soundings interpolated assuming them to be equally spaced except in those instances in conflict with the time record.

Volume dredged in first operation	--	200,000	cubic mts.
" " " second "	--	350,000	" "
" " " third "	--	420,000	" "
" " " fourth "	--	104,000	" "
Total	------	1,074,000	" "

The avarage cost per cubic meter was forty cents making a total cost in dollars of ----- $429,600

SEWERAGE DISPOSAL.- Twenty-six inch and sixteen inch thoroughly creosoted wood stave pipes provided with concrete drain boxes and man holes at adequate distances were used for sewerage disposal.

LAYING DOWN EIGHT INCH PIPE LINE ACCROSS PANUCO RIVER. Illustration number 1 shows the course of 8 inch pipe lines and the location of Tancol Station,source of all fresh water consumed at the refinery.

Before laying the pipe lines accross the river its course was dredged to a depth of 40 feet and ditches were dug on both shores to give it a gentle grade. The distance accross the river (376.54 mts. and 439 mts.) was carefully calculated by triangulation and a length of pipe long enough to have its ends projecting well out of the water on either shore was connected,placed on small cars running on a narrow gage track and thoroughly tested. At a prearranged hour all traffic along the river was stopt by the captain of the port and the following signals,equipment and crew were used in pulling pipe accross the river.

Signals.

To start or O.K. -- Move flag back and forth horizontally

To slow up ------- Move flag up and down Vertically

To stop --------- Wave flag violently over-head.

Engineers and Foremen were assigned to supervise the work :

On dredge with lever man.

On chalans carrying front end pipe

At Cecilia e d of line with gamg.

At Chijol end of line with gang.

Main signal men.

On tug upstream.

On gasoline boat down stream.

Giving line on center at Chijol.

Along pipe line.

Handling cars from track.

PILE FOUNDATIONS.

SEA LOADING PUMP AND BOILER HOUSES.- The tests carried out to determine the bearing power of the sites selected for the erection of the Sea Loading Pump and Boiler Houses having revealed their incapability of sustening the loads to be brought upon them,means had to be used to increase their bearing power. After careful consideration of the various methods generally used to fulfil this purpose the driving of wooden piles was adopted being considered the most convenient.

SPECIFICATIONS FOR PILES.- The piles used for these two foundations were specified to be not less than 8 inches in diameter at the small end nor more than 18 inches at the large end. They were further required to be straight grained, to be trimmed close, to have the bark removed and to be thoroughly impregnated with creosote. The small end was properly sharpened by the pile driving crew before being driven and the lenght varied from 30 to 45 feet as called for by the engineer supervising the work. Ocasionally in hard driving when the pile showed a tendency to split, the head was hooped with a strong iron band 2 inches wide and 1/2 inch thick.

PILE DRIVING MACHINE.- A drop-hammer pile-driver was used for this work. The method of operation was as follows : The piles were driven by a succession of blows given with a heavy block of iron when allowed to fall freely on the head of the pile.

The frame consisted of two uprights or wooden beams 45 feet long placed 2 feet apart which guided the hammer in its up and down motion. The hammer had a staple in its top by which it was raised and grooves on its sides to fit the guides.

A gasoline engine provided with a friction clutch was placed on the end of the scow to wind the cable when raising the hammer and by setting free the winding drum dropped the hammer from any desired height, thus securing a light or heavy blow as needed.

The supervising engineer directed the work to insure every pile being driven in the place called for by the foundation design and kept a record of the diameter,length, and number of each pile,number of blows,height of fall, penetration for last ten blows and calculated on the spot the safe load of each pile..

ROADS AND DRAINAGE.- Illustration number 4 shows in detail the general layout of roads,ditches,grades,cross-sections and drainage system. It is self explanatory and needs no further comment.

PART IV.

MECHANICAL EQUIPMENT.

POWER HOUSE.- Two,750 H.P. steam driven turbines with surface condensers directly connected to 2 three face 500 KW. G. E. Co. Generators. Usual values of voltage : 220 and 125 for exterior and interior illumination respectively.

2 - Worthington Co. condensers

2 - Eight inch circulating water pumps

2 - One and a half inch,2 stage hot well pumps

2 - Nine feet air ejectors.

BOILER HOUSE.

4 - 500 H.P. Heine boilers

1 - 500 H.P. Sterling boilers

2 - 250 H.P. " "

1 - 3 1/4" x 4 3/4" x 5" Worthington duplex pump

1 - 16" x 9" x 12" Fire pump

3 - 12" & 18" x 8" x 12" Pumps

4 - 6" x 4" x 6" Fuel oil pumps

3 - 26' dia. x 25' Boiler feed oil tanks.

SEA LOADING BOILER HOUSE.

2 - 500 H.P. Heine boilers

1 - Oil burning set

2 - Boiler feed pumps

1 - Cameron Pump

1 - Feed water heater

1 - 25' dia. x 20' Fuel oil tank

1 - 25' dia. x 20' Fresh water tank.

SEA LOADING PUMP HOUSE.

1 - 14" & 22" x 11" x 18" Duplex cargo oil pump

6 - 14" & 25" x 14" x 24" " " " "

Worthington Pump & Mfg. Corporation.

SALT WATER PUMP HOUSE.

1 - 16" D. S. Pump with H4H 2 stage turbine

2 - 6" type "S" motor driven centrifugal pumps Chalmers

5 - 8" type " " " " " "

CRUDE OIL PUMP HOUSE.

2 - 12" x 9 1/2" x 18" Wilson Snyder duplex pumps

2 - 12" x 8 1/2" x 18" " " " "

COMPRESSOR AND AGITATOR PUMP HOUSE.

1 - 9" x 15" x 10" Chicago Pneumatic air compressor

1 - 6" x 7 1/2" x 6" " " " "

6 - 7" x 7" x 10" Fairbanks Morse duplex pumps.

AGITATORS.

2 - 1000 barrel agitators

2 - 600 barrel "

1 - 6' x 6' acid tank

1 - Centrifugal pump

4 - 3'-6" dia. x 6' long blow cases

1 - 4' dia. x 4' high soda melting tank

1 - 6' " x 6' " " " ".

WATER SOFTENER AND SAND FILTER PLANT.

1-- 12000 gallon per hour Sorge Cochrane feed water softener

1 - 7000 gallon per hour water softener

1 - 12000 gallon per hour sand filter

1 - 7000 gallon per hour sand filter

2 - Chemical tanks connected to 2 motor driven pumps

1 - 20' dia. x 10' Tank for filtered water.

BLACKSMITH AND MACHINE SHOP.

1 - 1100 lb. Bement steam hammer

1 - 16" Pipe cutter

2 - 12" " "

1 - 6" " "

1 - 8" x 10" Aves steam engine

1 - 12" Lathe

1 - 24" South Bend lathe

1 - Lathe

1 - Grinder

2 - Drill presses

1 - Radial drill

1 - Bolt cutter

1 - Hack saw

1 - 15 H.P. Auxiliary Gas engine

1 - Acetyline welding outfit

1 - Punch and shear

7 - Forges

ICE PLANT.

1 - 6" x 12" Ammonia belt driven compressor

1 - 3 H.P. Motor

1 - No. 20 Blower

1 - Centrifugal pump

1 - 10 H.P. Motor

FOAMITE PUMP STATION.

2 - Foamite twin duplex steam pumps

4 - 25' dia, x 20' Foamite storage tanks.

LOCOMOTIVES.

1 - Porter standard gage, steam driven locomotive

2 - Industrial Works locomotive cranes.

Capacity without jack beams

30,000	lbs.	at	12'	Radius
19,200	"	"	20'	"
11,200	"	"	30'	"
7,500	"	"	40'	"

A AND B UNITS.

The equipment of A and B units is identical with the exception of the Main Oil Pump House which serves both units. Below is given the equipment for one unit.

MAIN OIL PUMP HOUSE.

3 - 10" x 6" x 12" Platt Iron Works duplex pumps

11 - 7" x 7" x 10" Fairbanks Morse " "

2 - 8"x8 1/2" x12" " " " "

2 - 7" x 5 1/2" x 12" Wilson Snyder duplex pumps

5 - 8" x 7 1/2" x 18" " " " "

2 - 6" x 5 3/4" x 6" Fairbanks Morse " " .

A UNIT NO.2 PUMP HOUSE.

5 - 7" x 5 1/2" x 12" Wilson Snyder duplex pumps.

A UNIT NO.3 PUMP HOUSE.

5 - 7" x 5" x 10" Thompson hot oil duplex pumps.

A UNIT NO.3 ASPHALT PUMP HOUSE.

5 - 8" x 5" x 10" Hot oil pumps.

A UNIT NO.1 FRACTIONATING PLANT.

6 - 5 1/4" x 4 3/4" x 5" Henry Worthington duplex pumps.

RECEIVING HOUSE.

2 - 3" x 2" x 3" Platt Iron Works duplex pumps.

DEPHLEGMATORS.

3 - 6' x 17'-8" Dephlegmators.

3 - 4' x 13'-6" " .

SUPERHEATERS.

3 - 14" x 25' Oil fired superheaters.

HEAT EXCHANGERS.

6 - 48" x 178"-2" x18' Double tube heat exchangers.

VERTICAL CONDENSERS.

8 - 30" x 70" x 2" x 18" Tube condensers.

INJECTION CONDENSERS.

4 - 36" x 95" - 2" x 8' Single tube sheet condenser.

ASPHALT HEATERS.

1 - 16'-3" x 20' Pipe asphalt heater.

SURGE TANKS.

4 - 8' x 30' Surge tanks.

ASPHALT FUEL TANK.

1 - 20' x 12' Asphalt fuel tank with steam coils.

ASPHALT COOLERS.

2 - 7'-1" x 25'-6" Asphalt coolers.

C AND D UNITS.

MAIN OIL PUMP HOUSE.

3 - 10" x 6" x 12" National Transit Co. duplex pumps

11 - 7 1/2"x 7"x 6" Henry Worthington " "

2 - 7"x5 1/2"x 12" Wilson Snyder " "

5 - 8"x7 1/2"x 18" " " " "

2 - 6"x5 3/4"x 6" Fairbanks Morse " " .

STILL PUMP HOUSE.

1 - 12"x9 1/2"x18" Wilson Snyder duplex pump

8 - 7"x5 1/4"x12" " " " "

4 - 6" x 4" x 6" Henry Worthington duplex pumps

6 - 8" x 6" x 6" Kinny pumps coupled to

6 - 8" x 6" Troy engines.

2 - 16'- 3" x 20' Asphalt heaters.

4 - Foster Superheaters.

HEAVY DISTILLATE PUMP HOUSE.

4 - 7" x 5 1/2" x 12" Wilson Snyder duplex pumps.

CIRCULATING DISTILLATE PUMPS.

8 - 5 1/4" x 4 3/4" x 5" Circulating distillate pumps.

RECEIVING HOUSE.

4 - 3" x 2" x 3" Platt Iron Works duplex pumps.

SUPERHEATERS.

2 - 14" dia. x 25' Oil fired superheaters.

STILLS.

1 - Battery of 4 - 11' x 40' Rerun stills.

4 - " " " " " Lubricating stills.

1 - " " " " " Asphalt stills.

HEAT EXCHANGERS.

12 - 48" x 178" - 2" x 18' double tube heat exchangers.

DEPHLEGMATORS.

8 - 6' x 17'-8" Dephlegmators

12 - 4' x 13'-6" "

12 - 3' x 12' "

CONDENSER BOXES.

32 - 7' x 9' x 30' Condenser boxes.

FRESH WATER TANKS.

2 - 12' x 6' Fresh water tanks

2 - 12'x4'-6" " " "

STEEL TANKS.

1 - 76' Dia.	x 30'	Fresh water tank		
1 - 56' "	x 30'	" " "		
1 - 28' "	x 15'	Salt " "		
4 - 36' "	x 7'-6"	Tanks connected to	1000	Bbl. Agitators.
4 - 28' "	x 7'-6"	" " "	600	" "
54 - 36' "	x 30'	Unfinished products tanks		
16 - 20' "	x 6'	For A and B Units		
12 - 30' "	x 12'	" " " " "		
20 - 30' "	x 12'	" C " D "		
16 - 20' "	x 6'	" " " " "		

12 - 55,000	Bbl.	Crude oil	tanks
4 - 55,000	"	Fuel "	"
1 - 55,000	"	Gas "	"
2 - 55,000	"	Lubricate	"
1 - 37,500	"	Gasoline	"
1 - 37,000	"	Kerosine	"
2 - 55,000	"	"	"
2 - 55,000	"	Gasoline	"
1 - 64,000	"	Lubricate	"
1 - 64,000	"	Fuel oil	"

BUENA VISTA TANK FARM.

53 - 64,000 Bbl. Crude oil storage tanks.

PART V.

OPERATION.

INTRODUCTION.- The refining of petroleum is based upon the separation of the component hydrocarbons by a process of fractional distillation. In this refinery a continuos system is used involving a series of stills which are heated to successively higher temperatures. The crude oil flows from one to the other and from each one there passes off the product volatilizing at the temperature to which the still is heated.

GENERAL DESCRIPTION OF OIL REFINING PROCESS.- The crude oil to be refined is taken from 55,000 barrel crude oil storage tanks on the terminal. Pumps installed in crude oil pump house pump the oil to 11 meter diameter by 9 meter high tanks where it is heated and measured. From these tanks the oil is sent to the fractionating plants where it is heated to a temperature of 200 degrees centigrade and the vapors formed at this temperature are separated from the liquid.

The vapors from the fractionating plants are passed through dephlegmators where they are separated and on being condensed yield distillates of various specific gravities. The distillates thus obtained are sent to receiving tanks passing on their way through the receiving houses where they are inspected. From the receiving tanks the distillates proceed to the unfinished products tanks.

The residuum obtained from the fractionating plants is passed through heat exchangers where the crude is reheated and sent to receiving tanks. From these receiving tanks it is pumped to first unit topping plants where it is heated to a temperature of 270 degrees C. The vapors formed at this temperature are condensed and run to receiving tanks passing on their way through the receiving houses to be inspected.

The hot residuum from first unit topping plants is pumped to second unit topping plants where it is heated to a temperature of 340 degrees C. The vapors formed at this temperature are condensed and separated and passing through the receiving house flow to receiving tanks from which this distillate is pumped to 55,000 barrel storage tanks. The residdum obtained from second unit topping plants is cooled and stored to be sold as asphalt.

From the unfinished products tanks gasoline and kerosine are pumped to 4 agitators where they are treated with sulphuric acid and soda and after being washed with water run to receiving tanks from which they are pumped to 55,000 barrel storage tanks on the terminal.

THE END.