PLANT REQUIREMENTS FOR MANUFACTURE OF CENTRIFUGAL CAST IRON PIPE

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
COMMUNICATIONS RESOURCES DIVISION
Washington 25, D. C.

FOREWORD

This brochure is one of a series of reports resulting from overseas technical inquiries on factory or commercial establishments, operation, management, and engineering. The report is designed to provide only a general picture of the factors that must be considered in establishing and operating a factory of this type. In most cases, plans for actual installations will require expert engineering and financial advice in order to meet specific local conditions.

Mention of the name of any firm, product, or process in this report is not to be considered a recommendation or an endorsement by the Agency for International Development, but merely a citation that is typical in its field.

This report was prepared by the George H. Andrews Engineering Associates, Inc., 411 Southern Building, Washington 5, D. C., in September 1960 for the technical aids program through the facilities of the Office of Technical Services, U. S. Department of Commerce.

* * * * * * *

For further information and assistance, contact should be made with the local Productivity Center, Industrial Institute, Servicio, or United States AID Mission.

Code Number
PR-~~104~~
101

February 1962

ACKNOWLEDGMENT

The author gratefully acknowledges the cooperation, assistance and technical information provided for the preparation of this report by the engineers of --

The Centrifugal Casting Machine Co.
P. O. Box 947
Tulsa, Oklahoma

This company manufactures a complete line of machinery for the production of centrifugal cast iron pipe.

This report was reviewed and approved by the President, Mr. Nathan Janco.

TABLE OF CONTENTS

C E N T R I F U G A L C A S T I R O N P I P E

INTRODUCTION

The purpose of this report is to present basic information for establishing and operating a small plant to produce centrifugal cast iron pressure pipe in a foreign country.

Plants producing centrifugal cast iron pressure pipe in the United States are usually designed for a much larger volume of production. However, the processing methods and equipment described in this report are modern and conform to those now being used in the United States.

GENERAL ASSUMPTIONS

In order to make realistic estimates in this manual, certain assumptions are made. These are:

1. The costs of the building and general facilities are based on United States prices.

2. Material costs are based on sizes and specifications of materials used in the United States.

3. Labor costs are based on the average for the industry as recently published by the United States Bureau of Labor Statistics.

4. Adequate transportation facilities are available at the plant site.

5. Adequate power and water are available at the plant site.

6. The plant operates eight hours a day, five days a week, fifty weeks per year.

7. No special provision is made for the training of new personnel. It is assumed that learners' rates are paid in such cases.

8. The following items cannot be estimated realistically:

   A. Land value.
   B. Distribution of selling costs.
   C. In-freight and out-freight.
   D. Administrative costs.
   E. Taxes.

   While general estimates will be made of each of these items, for the purpose of completing cost estimates, adjustment should be made in accordance with actual local costs.

   In fact, all cost estimates contained in this report should be adjusted to conform to local conditions.

9. Columns are provided in the tables included in this report to facilitate the conversion of cost figures to conform with local costs.

PRODUCT SPECIFICATIONS

The information and figures included in this report are based on the production of centrifugal cast iron pressure pipe with bell and spigot ends, in lengths of about five or six meters, with inside dimensions of four, six, eight and twelve inches, together with the required fittings. The pipe must withstand 300 psi pressure test and conform to ISO/R13-1955, International Organization for Standardization.

The pipe is to be cement coated and then tar coated inside and outside. The cement coating is for the purpose of protection from fungus growths and may be eliminated if not desired by customers. The tar coating inside and out, will always be used.

PRODUCTION CAPACITY

The plant is designed to produce about 35 tons of centrifugal cast iron pressure pipe and fittings per day of eight hours.

Based on current practices in the United States, this is a small plant. The recommended equipment and production methods are modern and have proven profitable when operated under conditions comparable to those assumed in this report.

MANUFACTURING UNIT

The manufacturing unit for centrifugal cast iron pipe is one ton.

MANUFACTURING OPERATIONS

1. Sort and break up scrap.
2. Weigh scrap, adding pig iron if desirable.
3. Place weighed material in furnace for melting.
4. Pour melted metal into ladles.
5. Move ladles with crane to casting machine.
6. Pour metal into casting machine.
7. Remove pipe from casting machine and place pipe on rails.
8. Roll pipe to cleaning area.
9. Clean inside of pipe with wire brush and flexible tube and roll pipe to testing area.
10. Test pipe for pressure and roll pipe to cement coating area.
11. Line pipe with thin coat of cement and roll to storage area.
12. Dip pipe in tar vat and roll to storage area.
13. Move pipe to yard and stack using fork lift truck.
14. Cores are made and delivered to the machine.

DIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Scrapyard man	1	$1.50	$ 3,000	_____
Melter	1	$2.00	4,000	_____
Melter helpers	2	$1.50	6,000	_____
Ladle operator	1	$2.00	4,000	_____
Pipe machine operator	1	$2.00	4,000	_____
Pipe machine helpers	2	$1.50	6,000	_____
Core maker	1	$2.00	4,000	_____
Core maker helper	1	$1.50	3,000	_____
Pipe cleaners	2	$1.50	6,000	_____
Pressure tester	1	$1.50	3,000	_____
Cement coating	1	$1.50	3,000	_____
Tar coating	1	$1.50	3,000	_____
Laborer	1	$1.50	3,000	_____
Fork lift truck operator	1	$1.75	3,500	_____
Totals	17		$55,500	_____

INDIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Actual
Manager	1		$12,000	
Metallurgist	1		8,000	
Bookkeeper	1		5,000	
Secretary	1		3,500	
Maintenance man	1	$2.00	4,000	
Maintenance helper	1	$1.50	3,000	
Receiving & shipping clerk	1	$1.75	3,500	
Totals	7		$39,000	

Note: Chemical analysis of materials used should be made at regular intervals. In most large cities a laboratory is usually available where these services can be obtained. If such services cannot be obtained locally, about $8,000. a year should be added to Indirect Labor for the employment of a chemist.

DIRECT MATERIALS

Cast iron scrap and pig iron are the principal direct materials. Either material may be used. However, a mixture of both, depending upon the analysis and cost of the scrap versus pig iron, is recommended.

The scrap should be very carefully sorted and should not contain scrap steel or any other scrap metal. It should be 100 percent cast iron scrap and/or pig iron. For the purpose of this report, the cost of materials is based on one-half scrap and one-half pig iron.

The rated capacity of this plant is thirty five tons per day. The processing loss will be somewhere between two and five percent. For the

purposes of this report, five percent production loss will be used. Therefore, the annual Direct Materials coet , bared on using cast iron scrap and pig iron will be as follows:

Cast iron scrap -- 17½ tons

Pig iron -- 17½ tons.

Based on 250 working days, the annual tonnage of product would be 8750 tons.

Allowing for five percent of 8750 tons as production loss, the annual amount of cast iron scrap and pig iron used would be 9188 tons.

Based on $55.00 per ton for cast iron scrap and $65.00 per ton for pig iron, the average cost of direct materials would be $60.00 per ton. On this basis, the annual cost of cast iron scrap and pig iron would amount to 9188 X $60.00 or $551,280.

SUPPLIES

Item	Annual Cost Estimated	Actual
Lubricants	$ 100	_____
Hand and cutting tools	300	_____
Welding rods	50	_____
Maintenance materials	1,000	_____
Refractories and spare parts	12,000	_____
Office supplies	200	_____
Core sand (50 tons)	350	_____
Carbon Dioxide	400	_____
Sodium Silicate	500	_____
Total	$14,900	_____

PRODUCTION TOOLS AND EQUIPMENT

Description	Number Required	Estimated Cost Unit Cost	Estimated Cost Total Cost	Actual Cost
Reverberatory furnace	2	$10,000	$ 20,000	
Furnace refractories and spare parts	2	$ 6,000	12,000	
Weighing scale	1	$ 500	500	
Ladles	4	$ 500	2,000	
Ladle refractories	4	$ 500	2,000	
Core boxes for each pipe size	4	$ 400	1,600	
Molds for each pipe size	12	$ 2,000	24,000	
CO_2 equipment	1	$ 500	500	
Muller	1	$ 2,000	2,000	
Air compressor, 10 hp.	1	$ 2,000	2,000	
Monorail hoist (2 tons)	1	$ 2,500	2,500	
Electric machine hoist service	1	$ 5,000	5,000	
Pipe machine (complete)	1	$90,000	90,000	
Cleaning equipment	1	$ 1,000	1,000	
Pressure testing equipment	1	$15,000	15,000	
Cement lining machine	1	$15,000	15,000	
Hoist for dipping	1	$ 2,500	2,500	
Tar dip tank	1	$ 2,000	2,000	
Fork lift truck	1	$ 3,000	3,000	
Wheelbarrows	4	$ 100	400	
Scrap breaking equipment	1	$ 3,000	3,000	
Hand lift truck	1	$ 400	400	

PRODUCTION TOOLS AND EQUIPMENT (continued)

Description	Number Required	Estimated Cost: Unit Cost	Estimated Cost: Total Cost	Actual Cost
Electric welder	1	$ 500	500	_____
Platform scales	1	600	600	_____
Molding equipment for fittings, including flasks, patterns and accessories	1	$25,000	25,000	_____
Core racks	2	200	400	_____
Total			$232,900	_____

OTHER TOOLS AND EQUIPMENT

Description	Number Required	Unit Cost	Cost: Estimated	Cost: Actual
Hand tools			$300	_____
Cutting tools			100	_____
Bench grinders	1	$300	300	_____
Total			$700	_____

FURNITURE AND FIXTURES

Description	Number Required	Unit Cost	Cost: Estimated	Cost: Actual
Desks and chairs	3	$150	$ 450	_____
Typewriter	1	$150	150	_____
Adding machine	1	$150	150	_____
Filing cabinets	4	$ 75	300	_____
Total			$1,050	_____

PLANT LAYOUT

A plant layout, showing the locations of the machinery and equipment and the work flow, is included on Page 29.

PLANT SITE

To provide for eventual expansion, the land for the plant site should contain about five acres. The site should be level, well drained, and should be located as advantageously as possible with respect to transportation, power, water, fuel and sources of markets and labor. The cost of such a site is estimated at $5,000. including improvements.

BUILDING

A one-story building 100 feet X 200 feet, or 20,000 square feet, will provide ample space for all operations. In the area where the pipe machine is located the building should have 20 foot side walls. It is estimated that the complete building, including adequate plumbing and wiring will cost about $4.00 per square foot, or a total of about $80,000.

POWER

It is assumed that a dependable supply of electric power will be available from local public service lines.

Total connected load will be about 160 horsepower. Based on this connected load, the cost of power is estimated at about $3,200.

WATER

About 1,500 gallons of water is used per minute. However, much of the water is returned and reused. The plant should be located near a river or lake, if possible, where the only cost of water will be the pumping cost.

The annual cost of water is estimated at $1,000.

FUEL

Bunker C oil or gas should be used depending on local availability.

The annual cost of fuel is estimated at $12,000.

* * * * * * * * * * * * * * * * * * *

DEPRECIATION

Description	Estimated Cost	Years Life	Per Year Estimated	Per Year Actual
Building	$ 80,000	20	$ 4,000	_____
Production tools and equipment	$232,900	10	23,290	_____
Other tools and equipment	$ 700	10	70	_____
Furniture and fixtures	$ 1,050	10	105	_____
Total			$27,465	_____

MANUFACTURING OVERHEAD

Item	Cost Estimated	Cost Actual
Depreciation	$27,465	_____
Indirect labor	39,000	_____
Power	3,200	_____
Water	1,000	_____
Fuel	12,000	_____
Supplies	14,900	_____
Total	$97,565	_____

MANUFACTURING COST

Item	Cost Estimated	Cost Actual
Direct materials	$551,280	_____
Direct labor	55,500	_____
Manufacturing overhead	97,565	_____
Total	$704,345	_____

FIXED ASSETS

Item	Cost Estimated	Cost Actual
Land	$ 5,000	_____
Building	80,000	_____
Production tools and equipment	232,900	_____
Other tools and equipment	700	_____
Furniture and fixtures	1,050	_____
Total	$319,650	_____

WORKING CAPITAL

Item	Cost Estimated	Cost Actual
Direct materials, 30 days	$ 45,900	_____
Direct labor, 30 days	4,600	_____
Manufacturing overhead, 30 days	8,100	_____
Reserve for sales collections, 30 days	91,000	_____
Total	$149,600	_____

CAPITAL REQUIREMENTS

Item	Cost Estimated	Cost Actual
Fixed assets	$319,650	_____
Working capital	149,600	_____
Total	$469,250	_____

SALES REVENUE

The daily production of this plant is 35 tons of pipe.

The annual production would be 250 X 35 tons or 8,750 tons.

Based on a selling price of $125. per ton, the annual sales revenue would amount to $1,093,750.

RECAPITULATION OF COSTS, SALES AND PROFITS

Item	Estimated Cost		Actual Cost
Direct materials	$551,280		_____
Direct labor	55,500		_____
Manufacturing overhead	97,565		_____
Total manufacturing costs		$ 704,345	_____
Interest on loans	$ 15,000		_____
Insurance	6,000		_____
Legal	1,200		_____
Auditing	2,400		_____
Unforeseen expense	30,000		_____
Total administrative cost		54,600	_____
Sales commissions, travel freight-out, bad debts, discounts and allowances		60,000	_____
Profit before taxes		247,805	_____
Total annual gross sales		$1,093,750	_____

BUDGET CONTROL:

A requisition form designed to provide accurate records of procurement and indicate the purpose of procurement with the least amount of time and effort is shown on the following page.

This form has an account number for each type of the various expenditures which the manager will review in detail, monthly or oftener, in order to control his expenses. Some items, such as power and water, are usually under contract and are easily checked by reference to monthly bills. For simplification, items (marked with an asterisk below) are omitted from the purchase requisition. Variations in the labor costs are easily reviewed by examination of the payroll vouchers. The simplified type of control thus provided makes certain that the manager can control expenditures promptly.

Following the requisition form, a sample voucher check is shown. Voucher checks should be used for the payment of all expenditures and the appropriate book account number placed on each voucher.

At the end of each month the manager will receive a statement of all expenditures broken down by budget accounts. If the expenditures exceed the budgeted monthly allowances of any of the accounts, the bookkeeper will furnish the manager with a break-down of all expenditures relative to the budgeted accounts exceeded. All these supporting data can be secured by reference to the purchase requisitions and the check vouchers. This reference will enable the manager to determine what caused the over-expenditure and take corrective action.

If at any time during each month it becomes apparent that expenditures will exceed any of the budget accounts, the bookkeeper will bring this to the attention of the manager for his information and action.

BUDGET CONTROL ACCOUNTS:

Account Number		Monthly Expense	Monthly Budget	Annual Budget	Actual
10	Administrative	$_____	$ 2,050	$ 24,600	$_____
20	Sales	_____	5,000	60,000	_____
30	Direct Materials	_____	45,940	551,280	_____
40	Supplies	_____	1,241	14,900	_____
51	Power*	_____	266	3,200	_____
52	Water*	_____	83	1,000	_____
53	Fuel	_____	1,000	12,000	_____
60	Unforeseen Expense (Reserve Account)	_____	2,500	30,000	_____
71	Direct Labor*	_____	4,625	55,500	_____
72	Indirect Labor*	_____	3,250	39,000	_____
80	Depreciation (Reserve Account)	_____		27,465	_____

PURCHASE REQUISITION	COMPANY NAME	DATE

☐ 10 ADMINISTRATION ☐ 40 SUPPLIES

☐ 20 SALES ☐ 50 UTILITIES

☐ 30 MATERIALS ☐ 60 UNFORESEEN EXPENSE

INDICATE BELOW THE USE OF MATERIALS

☐ DIRECT MATERIALS ☐ MAINTENANCE SERVICES

☐ MAINTENANCE MATERIALS ☐ OPERATING SUPPLIES

	PLEASE ORDER THESE MATERIALS OR SERVICES	DELIVERY WANTED	
QUANTITY	DESCRIPTION	UNIT	TOTAL

QUOTES FROM		REQUISITIONED BY	
QUOTES FROM		APPROVED BY	
QUOTES FROM		ORDER NO.	ORDER DATE

R. W. MITCHELL MANUFACTURING COMPANY
1422 BOSWORTH STREET, S. E.

65-22
514

ANYWHERE, U. S. A. _____ 19____ No. 10000

PAY _____ DOLLARS $ _____

TO THE ORDER OF

R. W. MITCHELL MANUFACTURING COMPANY

TO FIRST NATIONAL BANK
ANYWHERE, U. S. A.

BY SAMPLE CHECK
VICE PRESIDENT

ACCOUNT NUMBER

Sample voucher check to be used for the payment of all expenditures in connection with Budget Control.

R. W. MITCHELL MANUFACTURING COMPANY

ENGINEERS:

The services of professional engineers are desirable in the design of this plant, even though the proposed plant is small.

A correct design is one which provides the greatest economy in the investment of funds and establishes the basis of operation that will be most profitable in the beginning and will also be capable of expansion without expensive alteration.

The addresses of professional engineers who specialize in industrial design, some of whom may be willing to undertake such work on low cost projects overseas, can be secured by reference to the published cards in various engineering magazines. They may also be reached through their national organizations, one of which is the

National Society of Professional Engineers
2029 K Street, Northwest,
Washington 6, D. C.

Manufacturers of industrial equipment employ engineers familiar with the design and installation of their specialized products. These manufacturers are usually willing to give prospective customers the benefit of technical advice by those engineers in determining the suitability of their equipment in any proposed project.

The equipment manufacturers also know, and can recommend, professional engineers in private practice, who are willing and able to provide appropriate consulting services.

TRAINING:

Manufacturing an inferior quality of product during the training period could create sales resistance that might be difficult to cope with later. To avoid such possibilities, the quality of the product should be maintained at all times, including the training period.

In some areas skilled operators may be available locally. In other areas all the operators may have to be trained.

If skilled operators are not available, adequate training would be assured by using one or more of the following methods:

A. If the plant is designed and installed by a competent engineering firm, the contract should be negotiated, if possible, on a turn-key basis. On this basis the contractor agrees to operate the plant and produce the quality and quantity of the product stated in the contract for an agreed period of time. Such a contract would assure adequate personnel training, since full quantity and quality could not be produced with an untrained organization.

B. The engineering firm that designs and installs the plant can usually make training arrangements to have key personnel placed, for training purposes, in a foreign industry that produces the same type of product. This would provide training for the key personnel while the plant is being installed.

C. If neither of the above methods is possible, then qualified and experienced individuals should be employed for the key positions, either permanently or temporarily, to perform the key operations and assist in training the organization, even if they must be secured outside the country.

D. The manager should have years of successful experience in this type of business and be fully qualified in all phases of management, including the training of employees.

SAFETY:

There is always danger of accident and injury in any industrial plant. Because of this, the manager should take specific action to bring to the attention of each employee the importance of safety precautions and intelligent first aid.

Practically all machines have safety appliances, and the manager should see that these are in good working condition and that the operators are making full use of them.

In addition to constant watchfulness to make sure that all practicable safety precautions are taken, first aid supplies should be readily available. One complete first aid kit should be maintained near the manager's office, and others at appropriate places throughout the plant. Some of the employees should be trained to provide first aid service.

The use of accident posters in the plant have proved to be of value in reducing accidents. It is recommended that such posters be used, and that some direct special action be taken by the manager, at least once each month, to bring to the attention of all personnel the importance of safety precautions.

A fire brigade should be established and each member trained as to his responsibility in case of fire. Fire drills should be conducted periodically.

It is recommended that the employees be encouraged to offer suggestions or recommendations relative to prevention of accidents, removal of fire hazards and maintaining general interest in all safety factors.

SUMMARY

A small plant, built and operate according to the assumptions made in this report would be a profitable undertaking.

Provision is made for inserting local cost in connection with all cost figures shown in this report. A careful analysis should be made of all cost figures to determine the local potential profits in any location where such a plant is being considered.

There are some determinations, however, that should be made before a decision is reached to build and operate such a plant.

For example, what are the possibilities of future expansion within the country for this industry?

What other products could be manufactured with the machinery and equipment specified in this report?

Is there a market for such additional product

How does this industry compare with other industries that may be needed in the country relative to the following factors:

1. The economic value to the country.
2. The needs of the majority of the people.
3. The amount of investment capital required.

Consideration should also be given to such factors as:

The amount of power required and the availability of a dependable supply. If an adequate supply is not available the installation of power equipment may be required.

The water requirements for all purposes including fire protection and potable water for drinking purposes.

The fuel requirements and availability. If local fuel can be used the boiler should be adaptable to such fuel.

The transportation facilities to and from the plant. If they are not adequate an investment in trucks may be required.

OTHER CONSIDERATIONS

There are other important subjects, shown below, that should be fully investigated and considered. Information on these subjects is usually available from such sources as banks, government agencies, exporters and importers, wholesalers, retailers, transportation companies and manufacturers.

MATERIALS AND SUPPLIES

1. Are all materials and supplies available locally?
2. Is the local material market competitive?
3. Is satisfactory delivery of local materials assured at reasonable prices?
4. What materials and supplies must be imported?
5. Are they available in world markets at competitive prices?
6. Would prompt delivery of imported materials and supplies be assured so that large inventories would not be required?

MARKET FACTORS

1. Is there already a demand for the product?
   - A. Who are the principal consumers?
   - B. Who are possible new consumers?

2. How is demand for the product now satisfied?
   - A. By local production? If so, what is the volume of annual production?
   - B. What percentage of consumption is filled by local production?
   - C. By imports? If so, what is the volume of annual imports?
   - D. What percentage of consumption is met by imports?
   - E. From what areas are imports derived?

3. What is the estimated annual increase in local consumption over the next five years?
   - A. How were such estimates made?
   - B. By reference to official figures on population growth, family budgets, imports, etc.?
   - C. By consultation with trade or industry, ministries, associations, bankers, commercial houses, wholesalers, retailers, industrial consumers, etc.?

4. If the product is already being manufactured, can the existing and estimated future local market absorb production of the new plant without price-cutting or other dislocations?

5. Would the estimated sales price and quality of the new product make it competitive with an imported equivalent?
   A. After adjusting cost to local conditions, is the estimated sales price of the product so high that tariff protection is necessary to protect it from imports?

EXPORT MARKETS:

1. Could the product compete in export markets on the basis of price, quality and dependability of supply?
2. Can export markets for the product be developed?
3. If so, in what areas and in what annual volume?
4. What procedures would be necessary to develop export markets?
5. What would it cost?

MARKETING PROBLEMS:

1. In calculating costs of the product, has adequate allowance been made for the expense of a sales department, advertising and promotion that might be required?

2. Do consumer prejudices against locally manufactured products exist?
   A. If so, why?
   B. Would they apply to the new product?
   C. If so, how could they be overcome and what would it cost to do so?

3. Do marketing and distribution facilities for the product exist?
   A. If not, can they be set up?
   B. What would it cost to do so?

4. Will the product be sold to:
   A. Wholesalers?
   B. Retailers?
   C. Direct to consumer?
   D. Other industries?
   E. Government?

FINANCIAL FACTORS:

1. Technical advice on selection of machinery and equipment.
   - A. In selecting the machinery and equipment for the new plant, have reputable and competent engineers and technicians been consulted?
   - B. Have they been asked for advice on the most suitable types of machinery and equipment for the process and locality?
   - C. Have they carefully compared costs of various suppliers?
   - D. Credit terms offered purchasers?

FINANCIAL REQUIREMENTS OF THE PROJECT:

1. In estimating the cost of the project, has careful consideration been given to:
   - A. The effect on costs of delays in construction schedules?
   - B. In delivery and installation of machinery and equipment?
   - C. In import of essential raw materials and supplies?

2. In calculating cash flow and working capital requirements, has careful consideration been given to:
   - A. Maintaining adequate inventories of raw materials?
   - B. Supplies and spare parts?
   - C. Seasonal fluctuations in the business?
   - D. The time required to liquidate credit sales to customers and bad debts?
   - E. The period necessary to get the plant into production?
   - F. Cash required to amortize its principle loans?

3. If the economy is in a period of inflation, has full allowance been made for the influence of rising prices and wages on the cost of the project and on working capital requirements?

SHORT TERM BANK CREDITS:

1. Has it been possible to make arrangements with local banks to finance short-time working capital requirements of the business?

FINANCIAL PLAN:

1. Has a definite plan to finance the project been worked out?
   - A. Is sufficient capital available locally?
   - B. If not, what is the plan to obtain the required capital?

ECONOMIC FACTORS:

1. How much foreign exchange (and in what currency) is required to import machinery, equipment and supplies:
   - A. How much foreign exchange (and in what currency) is required for annual interest payments and amortization of any loans contracted to import machinery and equipment, or for payment of royalties and technical services?
   - B. How much foreign exchange (and in what currency) is required for annual import of raw materials and supplies?
   - C. What are estimated annual foreign exchange earnings and in what currencies?
   - D. Has careful consideration been given to the possibility of depreciation in the foreign exchange value of the local currency?
   - E. Has careful consideration been given to the possibility of import controls, or restrictions on availabilities of foreign exchange necessary to operate the business?
   - F. What benefits would the new business bring to the economy in the use of local raw materials: in employment and in technology?
   - G. Do dependable facilities exist for transportation, power, fuel, water and sewage?
     - (1) If not, can existing deficiencies be eliminated satisfactorily?
     - (2) What would be the cost to do so?

PERSONNEL:

1. Is there an adequate labor supply near the plant location?
   - A. If not, how can the problem be solved?

2. Can the problem of training competent management and supervisory personnel be solved?
   - A. Also, the training of skilled labor?
   - B. Is technical advice available in the locality?
   - C. If not, where can it be obtained and what will it cost?

LAWS AND REGULATIONS:

1. Do existing labor laws, government regulations, laws and taxes favor establishment of new business?
   - A. If not, can existing obstacles be removed?
   - B. If so, how and when?

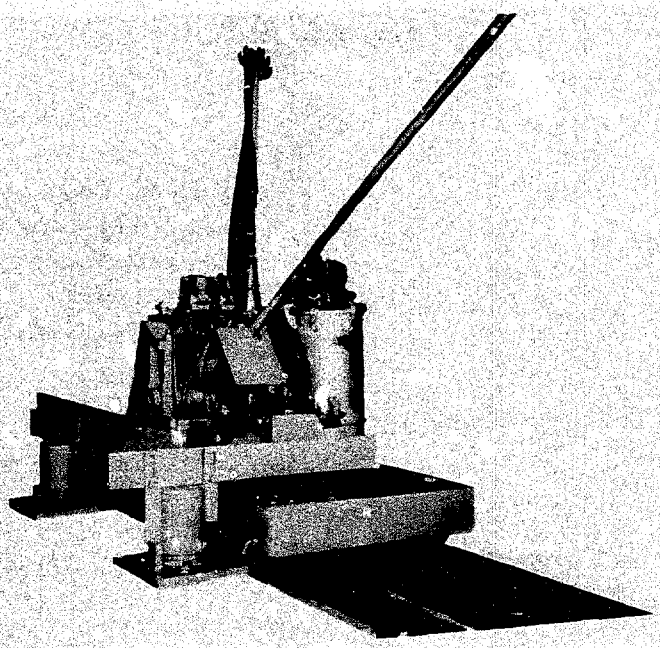
BIBLIOGRAPHY

Textbooks

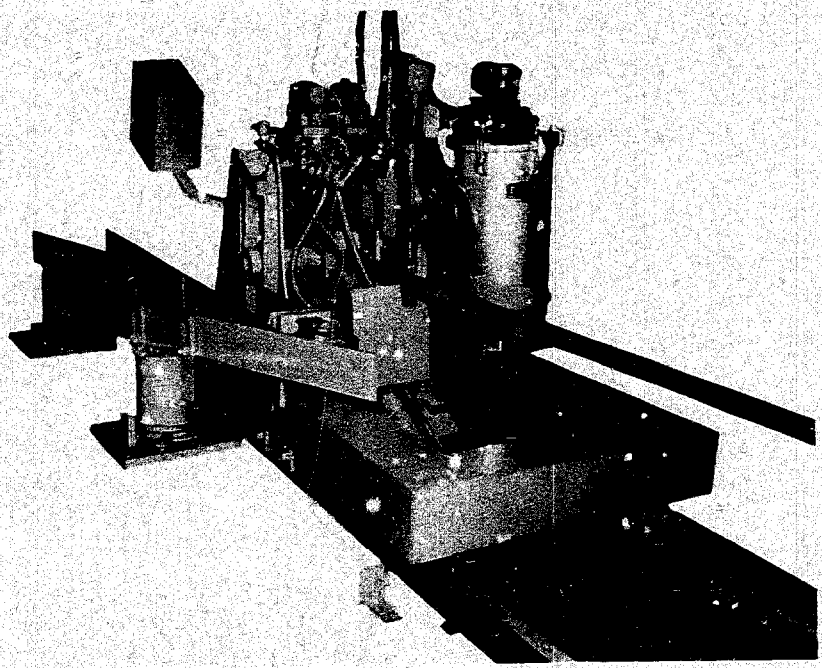
ASME Handbook	Samuel Hoyt Battelle Memorial Institute American Society of Mechanical Engineers 445 pp., $11.00.
Introduction to Foundry Technology	D. C. Ekey, Georgia Institute of Technology W. P. Winter, The Pennsylvania State University 296 pp., $7.00

ABBREVIATIONS

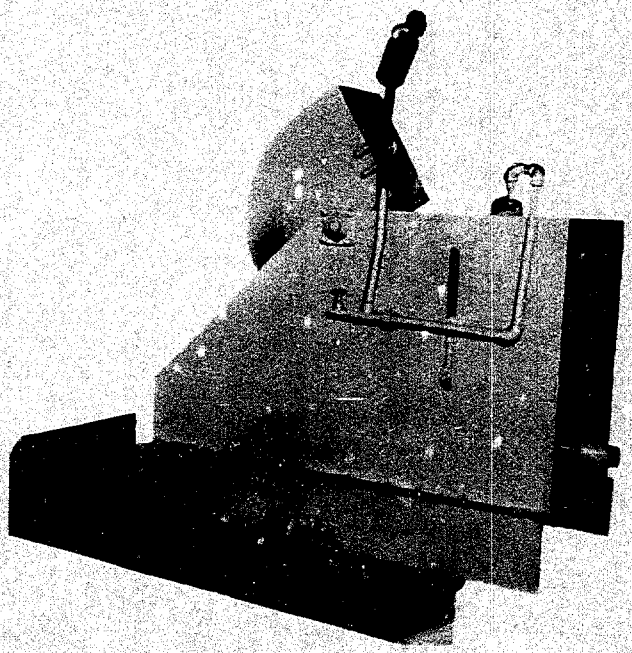
psi	-- pounds per square inch
CO_2	-- Carbon Dioxide
'	-- Feet
hp	-- Horsepower



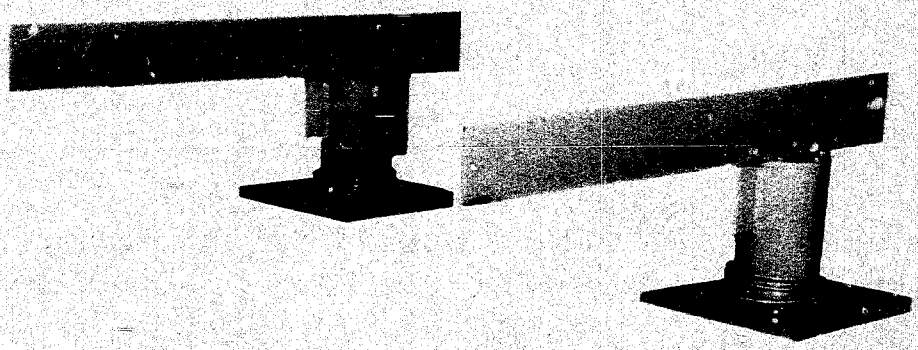
PULLING CAR WITH SPRAY LANCE UP.
PIPE PULLING TONGS IN PULLING POSITION.



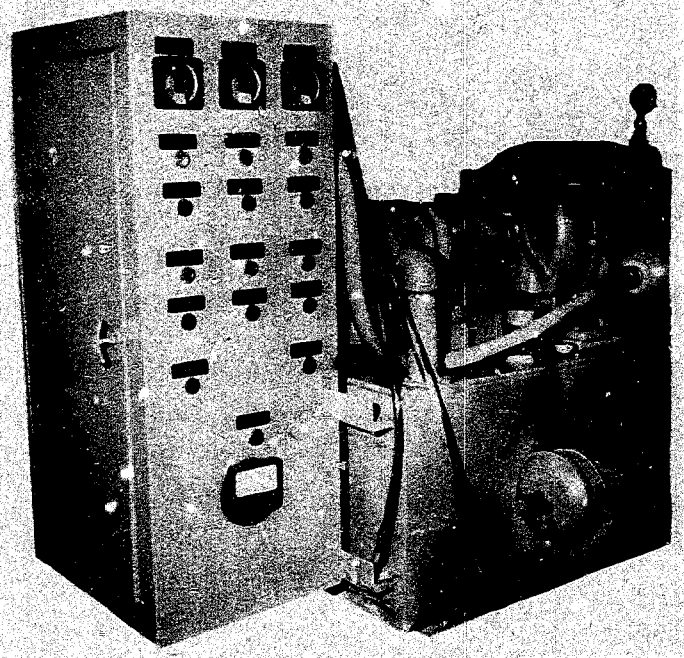
PULLOUT CAR WITH SPRAY LANCE
DOWN IN SPRAYING POSITION



AUTOMATIC POURING ASSEMBLY

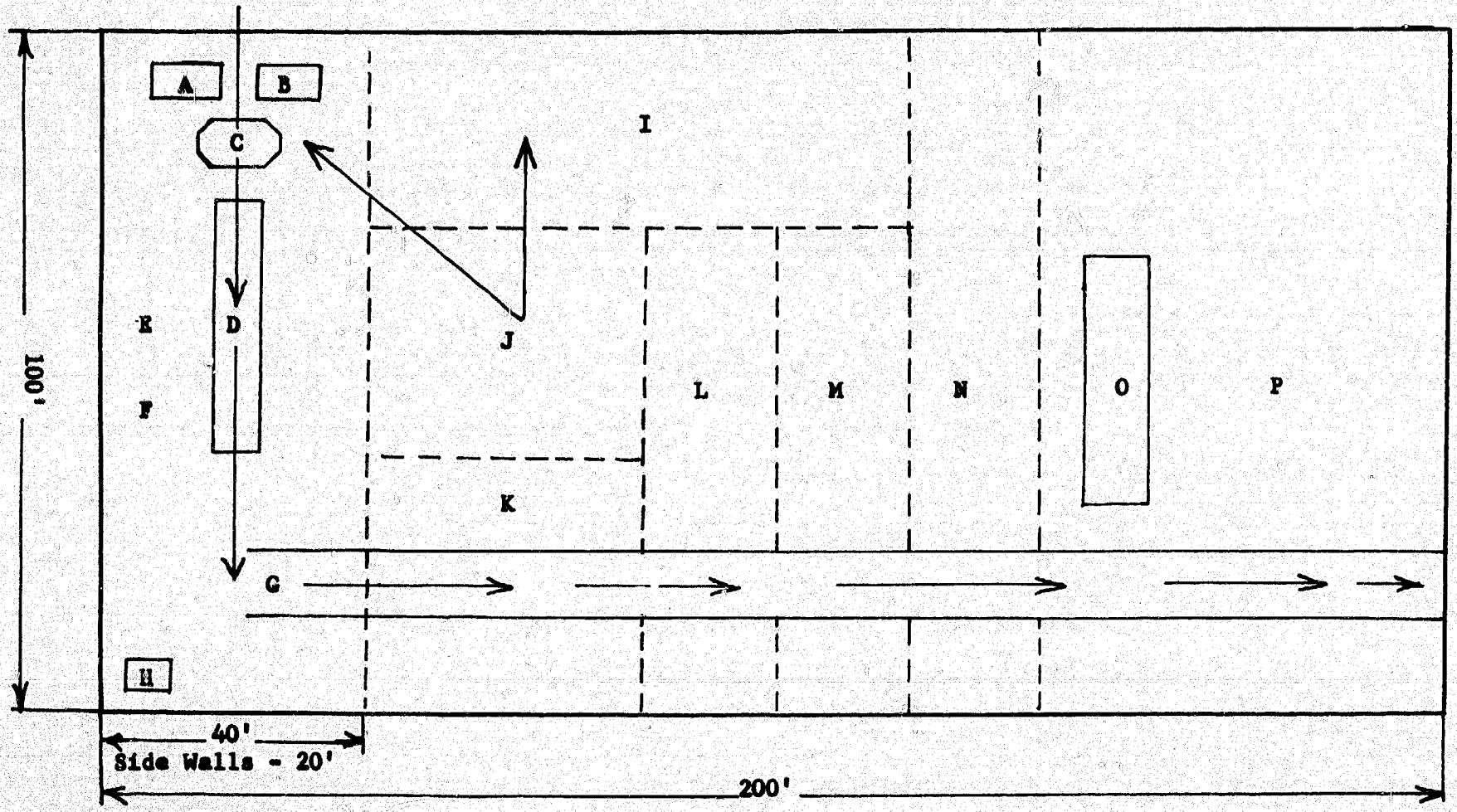


AUTOMATIC PIPE SUPPORTS



CONTROLS
HYDRAULIC POWER UNIT
IN BACKGROUND

PLANT LAYOUT AND WORK FLOW



A and B -- 2 Furnaces
C -- Loop track hoist
D -- Pipe machine
E -- Machine service hoist
F -- Track hoist, pipe to rails
G -- Pipe rails
H -- Compressor
I -- Foundry for fittings
J -- Core making
K -- Cooling area
L -- Cleaning area
M -- Testing area
N -- Cementing area
O -- Tar dip tank
P -- Tar coating area