PLANT REQUIREMENTS FOR MANUFACTURE OF CAMELBACK

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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 in September 1957 by the Wolf Management Engineering Company, Chicago, Illinois, for the industry program through the facilities of the Office of Technical Services, U. S. Department of Commerce.

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

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CAMELBACK

HISTORY

Prior to 1922 rubber tires of various types were recapped by vulcanizing and laminating three or four layers of tread gum rubber to the tire carcass. These layers were applied individually until the desired tread thickness was reached. However, due to inability to control temperatures, the process caused excess heat between laminations and failures resulted.

In 1922 a commodity known as "camelback" was developed. This material was designed to eliminate the lamination method and consisted of a specially prepared tread gum in strip form, with the desired thickness in the center and tapered to thinness at the edges.

Camelback, therefore, can be defined as an elongated sheet-like material of rubber or rubber compound, unvulcanized and with a planate or gummy surface which applies to the outer tire carcass. The opposite surface is mold treaded and has, as the tread area, contiguously disposed ribs longitudinally and spaced in uniform parallel relation.

USES AND CHARACTERISTICS

The principal use of camelback is in the field of tire retreading or recapping, and the process and methods set forth herein are directed toward that objective.

Before discussing the various stages involved in processing camelback, it may be helpful to point out the factors relative to its chemistry and composition. Pure latex or rubber is not used alone but must be compounded with other materials and chemicals. The materials used in such compounds are quite variable and numerous.

The proportions of latex, or "pure rubber," as it may be called, vary with the use to which the end product is to be put. Pure rubber can be made to serve innumerable uses through compounding with other ingredients. In the case of camelback, it must be compounded so as to withstand severe wear and yet retain the required elasticity.

In making camelback, understanding of the compounds is of considerable importance. There are also various grades and classes of camelback. Inasmuch as this report is directed toward the use of locally acquired latex or pure rubber compounded with other materials, there are indicated herein basic compounds which may be considered. These compound formulae indicate the proportion of pure latex involved and, as a matter of information, also indicate the present day synthetics in popular use.

PROCESSES

In this report, attempt has been made to outline a single process that would be most applicable to the average economic situation and location.

In the preparation of ingredients or compounds for processing, the initial steps are few. The smoked sheets must be clean and free of foreign matter such as paper or cloth fragments from wrapping or packing. The chemicals must likewise be kept free of foreign matter and should be stored in facilities where this condition can be maintained.

While the principles and concept of modern processing are adhered to in this report, the economics are based on the smaller capacity unit which would more normally suit the average requirement of a lesser developed economy than is found in the United States.

Since there are innumerable processes in the compounding and manufacturing of camelback, the prospective investor is cautioned to secure the services and advice of a reputable firm of consulting management engineers before embarking upon such an enterprise. They would prepare a complete administrative, operative and financial analysis commensurate with local conditions.

This report is primarily based upon a compounding process which would utilize locally available latex or pure rubber. Costs shown, therefore, are entirely relative and would vary with location, availability of raw materials, climatic conditions, type and class of labor, transportation facilities and marketing of end products.

While the chart on the following page illustrates several compounding processes, the method described under "Compounding" is based upon formula illustrations (a) and (b).

CAMELBACK COMPOUNDS

Class	Smoked Sheet	Reclaim Tire Tube	Solvent	Plasticizer	Activator	Anti-oxidant	Accelerator Activator	Carbons	Vulcanizing Agent	Accelerator Retarders	Sun-proofing Wax	Extender
(a) Super-grade (using natural rubber)	100		2	1	3	2	3	50	3	3		
(b) A-grade (using natural rubber)	100		1	4	2.5	1	3	45	2.75	1		
(c) B-grade (using natural rubber and whole tire reclaim)	88	22		2	3	1.5	3	45	2	1		
	Synthetic											
(a) Grade A (using synthetic and whole tire reclaim)	90	20		3	1	1	5	45	1.75	.75	3	8
(b) Grade B (using synthetic and whole tire reclaim)	8[illegible]	36		2	1	.75	4	19* 20	2	1.5	3	8
	Smoked Sheet	Reclaim Tire Tube										
Cushion Gum Compound	80	33	.8	5	1	1	5	25*	2.5	1.8		
Tread Repair Stock Compound (using tube reclaim black)	80	33	.8	5	1	1	5	20* 30	3	1		

* Fine thermal carbons -
Other types are channel blacks.

Note: All figures shown are in pounds.

Chemical Glossary

Smoked Sheet - Pure crepe latex.
Solvent - Mixture of oil-soluble sulphonic acid of high molecular weight with hydrophobic alcohol of high boiling point.
Plasticizer - Mixture of oil-soluble sulphonic acid of high molecular weight with a paraffin oil.
Activator - Stearic acid.
Anti-oxidant - Mixture of phenyl-β-napthylamine and diphenyl-p-phenylene diamine.
Accelerator Activator - Zinc oxide.
Carbon blacks - Fine thermal - medium thermal and channel blacks.
Vulcanizing Agent - Sulfur.
Accelerator Retarders - Benzoic acid, salicylic acid and phthalic acid. Can be used singly or in combinations of 1 and 2, or, 1, 2, and 3.
Sunproofing Wax - Pre-blended combination of waxes.
Extender - Mineral rubber - air blown bituminous residue from petroleum.

COMPOUNDING

Reference to the chart will show that the ingredients are proportioned in conformity with weight. Each unit of compound must be carefully weighed before mixing.

The liquids are usually mixed in one container, dry ingredients in another, and the stock or "crepe latex" (smoked sheets) cut into pieces approximately 12 inches by 18 inches. Where convenient, the smoked sheets can be stripped in pieces 8 inches by 4 or 5 feet. The proportionate compounds comprising a batch, or "charge," are then ready for the machine.

Various manufacturers in the United States are conducting experiments directed toward machine designs which will permit plasticizing rubber compounds and extruding in one operation. This would eliminate the intermediate operation now required in a warm-up mill and extrusion of camelback in the desired form and would would introduce the smoked sheets to the compounds at room temperatures. Thus far, however, the process is only in the experimental stages.

In a small production plant, the ingredients can be weighed, measured and controlled by ordinary container and hand-feed operations. In the slightly larger and major production plants, several types of mixers or blender equipment are used and automatically controlled as the materials are fed into the milling and extruder machines. Figures 1 and 2 illustrate some of the types of premixing equipment used.

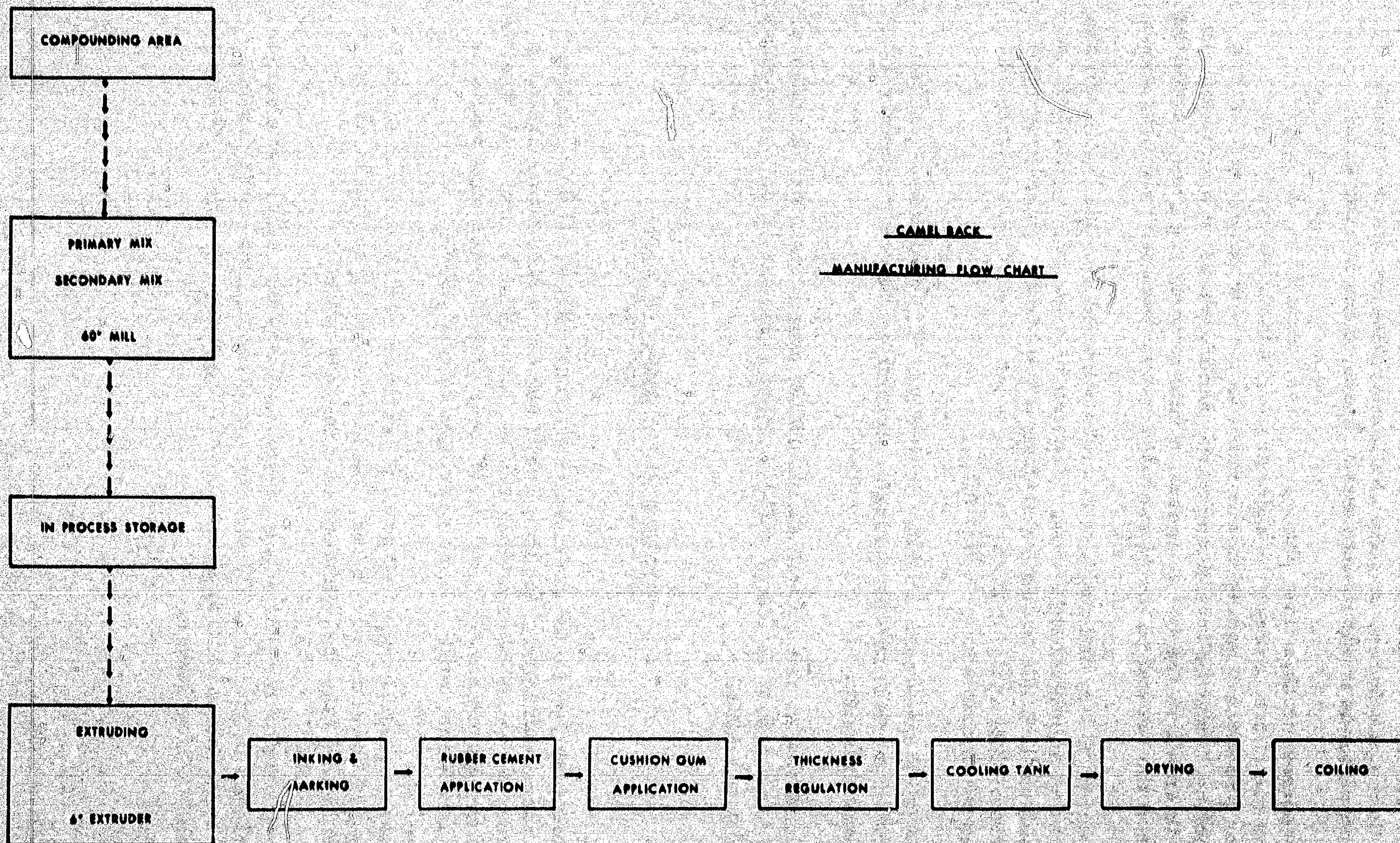
Since this report is concerned with the production of camelback, using locally available smoked sheets at a rate of approximately 300 lbs. of finished camelback per hour, the process and equipment shown herein are confined to the smallest economically feasible unit for such limited output.

MILLING AND EXTRUSION

This operation is divided into three phases. The first step following preparation of the required compounds is charging of the machine with the prepared batch. Figure 3 illustrates a typical machine used, the internal mixer. Basically, it is a two-roll mill entirely enclosed so that shear action is developed not only between the rolls, but also between the rolls and the enclosing shell. Variable rotor peripheral speeds are used from 115 feet to 230 feet per minute.

CAMEL BACK

MANUFACTURING FLOW CHART



These machines range in capacity of 100 lbs. to 875 lbs. per batch of rubber stock. Rotors are cored for water circulation as required to control temperatures, and the shells may also be water-cooled. The machine lends itself to automatic timing of the mixing cycle.

The ingredients in this first phase, or pass, consist of all those shown on the chart, except the sulphurs and accelerators. This operation produces a homogeneous mass in slab or sheet form which, after cooling, must be introduced to the second phase of operation. In a plant as small as the one proposed in this report, the sheets could be stored and the second phase of operation performed the following day.

In the second phase, the product is re-introduced into the mill, and the sulphurs and accelerators added. The batch or charge is then worked in the mill until it has become softened by heat to an approximate thermal equilibrium (depending upon the type of stock used), from whence it is strip-fed to an extruder or tuber mill.

Figure 4 illustrates such a mill. In this machine the warm, plastic, compounded stock is forced through a camelback die by a screw rotating in a closed cylinder.

In the third phase, the camelback materials come from the extruder die in strip form onto a series of rollers which apply the planate or gummed surface to one side.

CUSHION GUM APPLICATION

In a small plant, it is not considered economically feasible to manufacture the cushion gum, for this would require a laboratory mill. It is, therefore, assumed that the cushion gum would be obtained elsewhere. As a matter of information, to manufacture the cushion gum would require a laboratory mill costing approximately $5,000.

The rubber cements required are not included in this report, since they are a negligible economic factor, but in calculating costs the prospective investor should take this element into consideration.

The flow chart on the preceding page illustrates the successive stages of camelback production. These steps are inking, marking, rubber cement and cushion gum application, cooling tank, wringer blotting rolls, and coiling device.

ECONOMICS

In considering the economics of a plant of approximately 20,000 lbs. per month production, it must be borne in mind that this capacity is very small and that costs are entirely relative, varying with location, availability of raw materials, marketing, etc.

Since it is assumed, for this report, that camelback is to be manufactured in the limited quantity of 20,000 lbs. per month from locally available latex or raw rubber, consideration must be given to location that will facilitate ease of access to producing areas. Normally, plantations have a five-month harvesting and curing cycle in latex production.

The plant proposed herein, therefore, would have to fit its camelback production into this cycle of supply. This would mean that the plant would not operate in excess of six months each year. On the basis of 20,000 lbs. per month, the plant would process 240,000 lbs. in a six-month operating cycle. This, in turn, would approximate 40,000 lbs. per month plant capacity. On the basis of 20 working days per month, the daily capacity would be 2,000 lbs., or 250 lbs. per hour for an eight-hour working day.

Raw Material Requirements

Assuming that the flow of raw material supply would be continuous to meet the production schedule, it is assumed that smoked sheet inventory would not exceed one month's supply and chemicals (since some would require importation), a two months' supply. On this basis, and since projected operation requires 20,000 lbs. of finished product per month, the annual usage would be 240,000 lbs. at a total estimated cost of $61,938.

Building Requirements

In temperate zones, the building costs would be nominal. Structural steel framework with sheet metal siding would be adequate for housing machinery and equipment that would be harmed by open installation. The following is an estimated cost of a building judged to be adequate for a camelback plant:

30 ft. X 60 ft. building (estimated)	$10,000

Machinery and Equipment Requirements

Milling and Extruding

1 Mill, 60-inch	$ 23,000	
2 Electric motors, vari-speed, 75 hp.	8,000	
1 Extruder, 6-inch	13,000	
1 Die-head with interchangeable dies	2,100	
Total		$ 46,100

Marking and Cementing Section

1 Cementing roll	25	
1 Cement dispenser (pan)	15	
1 Marking roll (interchangeable rubber type)	200	
1 Inking roll	20	
1 Transfer roll	15	
1 Ink dispenser (pan)	15	
Total		290

Cushion Gum Application Section

1 Weight roll	100	
1 Soft rubber roll	75	
1 Cushion gum dispenser (stand)	75	
Total		250

Cooling Section

1 Cooling tank, 20 ft. in length	250	
1 Belt conveyor, equipped with vari-speed electric motor	2,500	
1 Belting and pulley	125	
Total		2,875

Drying Section

2 Cloth-covered blot rolls (wringer type)	100	
2 Blowers, 20-inch	300	
1 Take-off pulley and belting	125	
Total		525

Packaging Section

1 Coiling stand with 18-inch and 24-inch stops	100	
2 Rubber knives, 8 X 1-1/4-inch blade	3	
Total		103

Miscellaneous Equipment

1 Compounding scale	$ 150	
1 Over and under scale	125	
1 Air compressor and piping, 7-1/2 hp.	1,750	
1 Steam plant and piping, low-pressure	4,000	
1 Floor truck	18	
Miscellaneous tools, wrenches, pliers, etc.	100	
Total		$ 6,143
Total equipment expenditures		$ 56,286
Estimated installation costs		1,500

Total Cost of Plant (Estimated)

Building	$ 10,000
Machinery	56,286
Installation	1,500
Total cost of plant	$ 67,786

ANNUAL COST - SIX MONTHS' OPERATING CYCLE

Direct Labor

Compounding Section: 1 man @ $1.25 per hour	$ 1,200
Mixing Section: 1 man @ $1.25 per hour	1,200
Extruding Section: 1 man @ $1.25 per hour	1,200
Packaging Section: 1 man @ $1.25 per hour	1,200
Total direct labor per year	$ 4,800

Indirect Labor

Foreman - 1 man @ $2.25 per hour	$ 2,160
Clerk - 1 man @ $1.25 per hour	1,200
Total indirect labor per year	$ 3,360

Selling and General Expense (per year)

Selling expense	$ 4,000
Electricity	1,200
Total	$ 5,200

Sales Revenue

Based on daily production of 2,000 lbs. camelback.

2,000 lbs. X 120 days = 240,000 lbs. per year.

240,000 lbs. @ $0.43 = $103,200.

Estimated Working Capital

Inventory:		
Smoked sheet (1 month's supply)	$ 7,995	
Chemicals (2 months' supply)	4,656	
Work-in-process	- -	
Finished goods (5 days)	4,300	
Total inventory		$ 16,951
Direct labor (1 month)		800
Indirect labor (1 month)		560
Selling and general expense (1 month)		870
Total estimated working capital		$ 19,181

Estimated Fixed Capital

Land	- -
Building	$ 10,000
Equipment	56,286
Installation	1,500
Total estimated fixed capital	$ 67,786

Estimated Total Capital

Working capital	$ 19,181
Fixed capital	67,786
Total	$ 86,967

Profit and Loss Projection

The following is a profit and loss statement for a period of six months operation, based on indicated sales and operating cost ratios:

Net sales		$ 103,200
Less cost of goods sold:		
Latex or smoked sheet	$ 47,970	
Chemicals	13,968	
Direct labor	4,800	
Indirect labor	3,360	70,098
Gross profit on sales		33,102
Depreciation:		
Building (5%)	500	
Machinery (10%)	5,628	
Total depreciation	6,128	
Machinery installation	1,500	
Selling and general expense	5,200	12,828
Net profit (before taxes, insurance and miscellaneous expenses)		$ 20,274

CAMELBACK CONSULTANTS

National Rubber Machinery Company, Akron, Ohio
L. Albert & Sons, Trenton, New Jersey
Farrel-Birmingham Company, Inc., Ansonia, Connecticut
Wolf Management Engineering Company, Chicago, Illinois

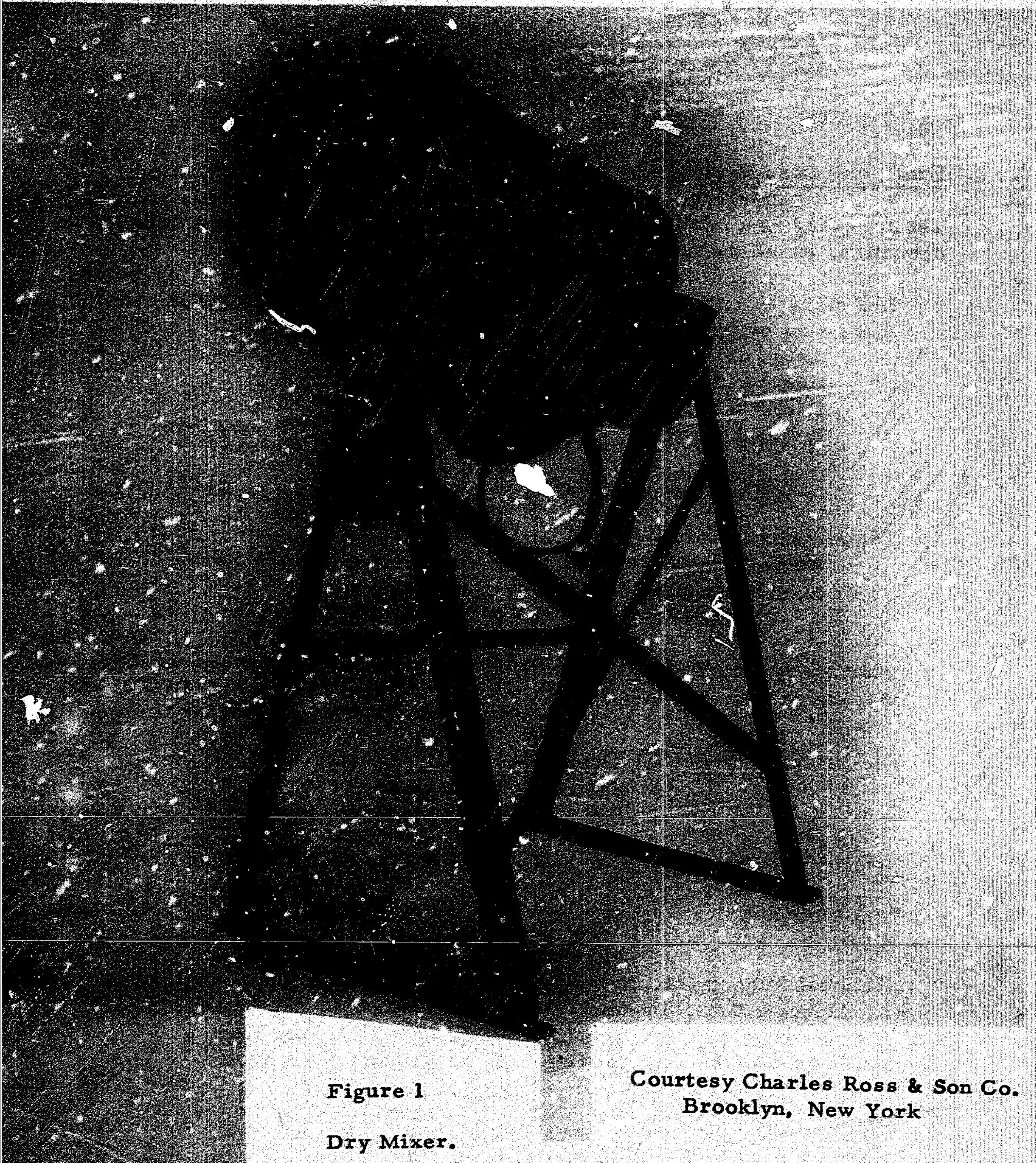
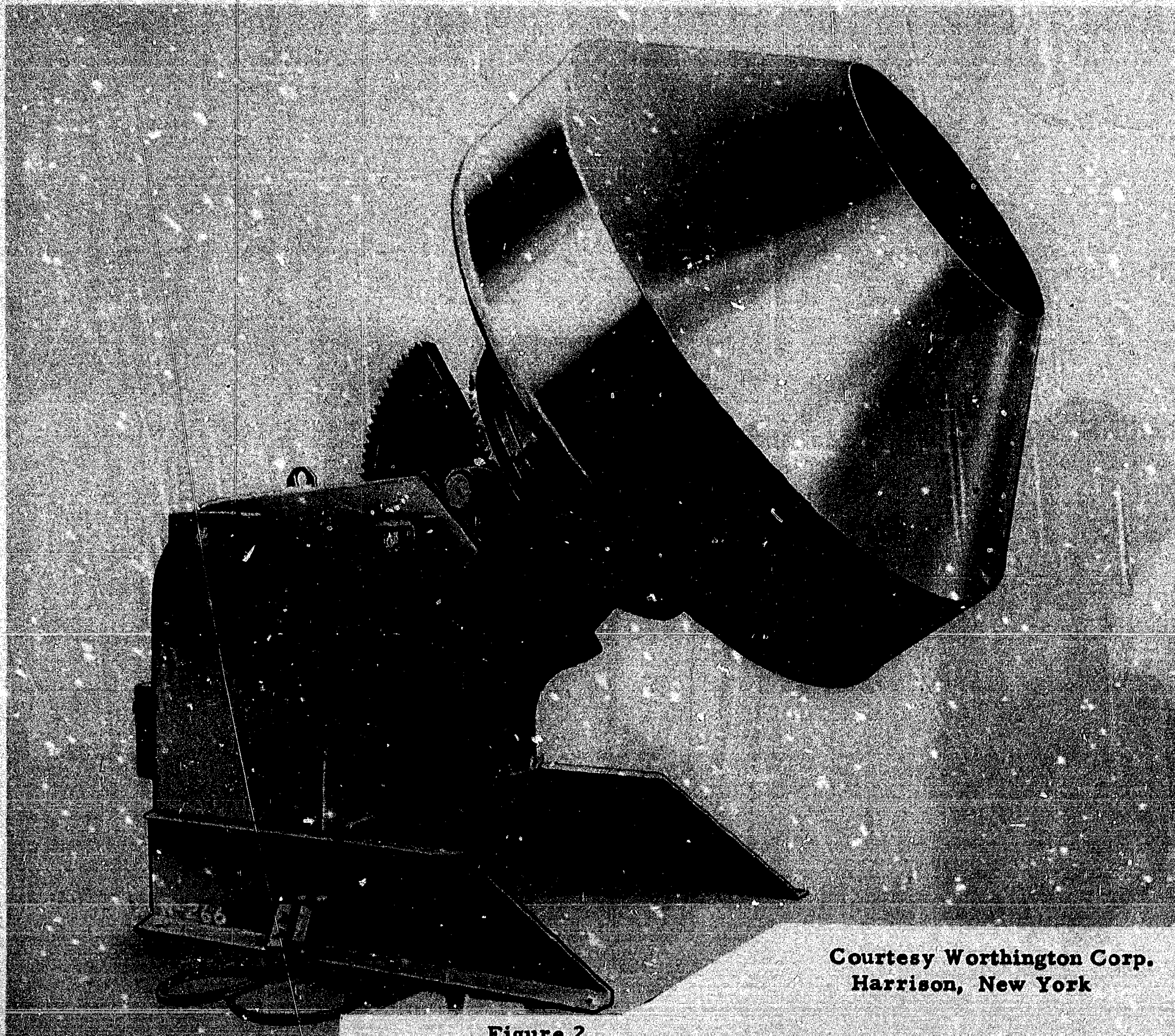


Figure 1

Dry Mixer.

Courtesy Charles Ross & Son Co.
Brooklyn, New York



Courtesy Worthington Corp.
Harrison, New York

Figure 2

Rotating Pan Type Mi

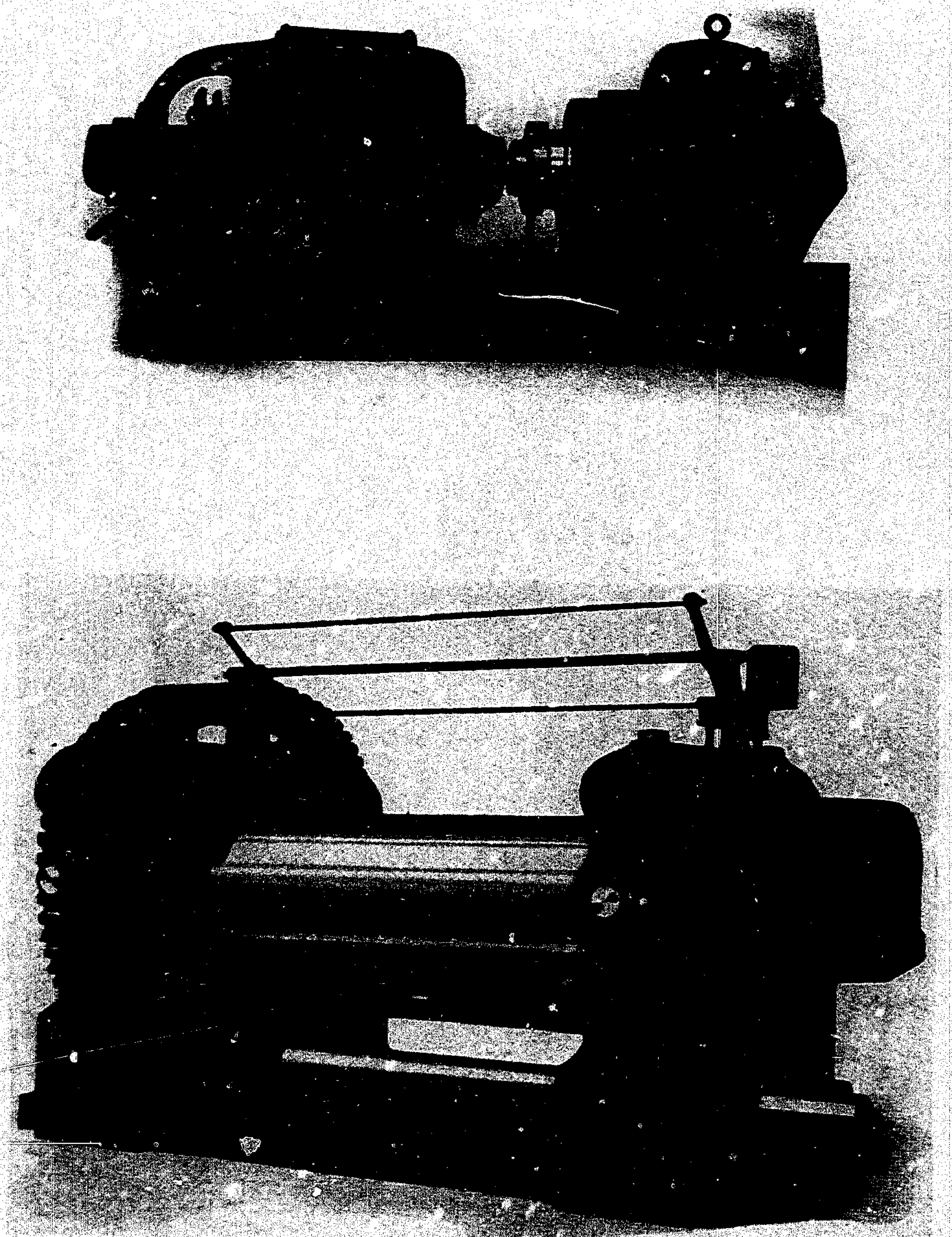


Figure 3

20 X 22 X 60-inch Heavy Duty Mill

Courtesy L. Albert & Son
Trenton, New Jersey

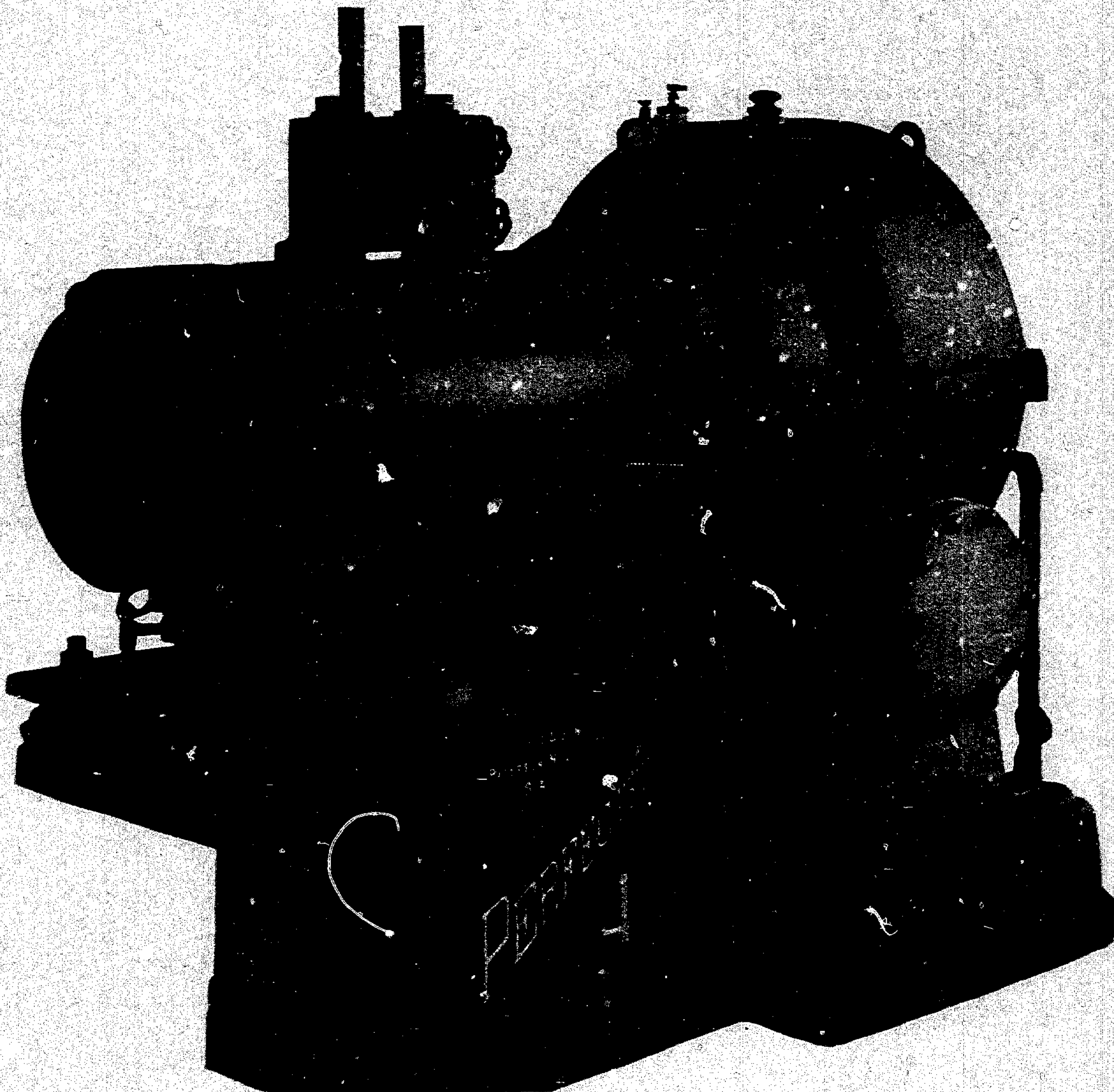
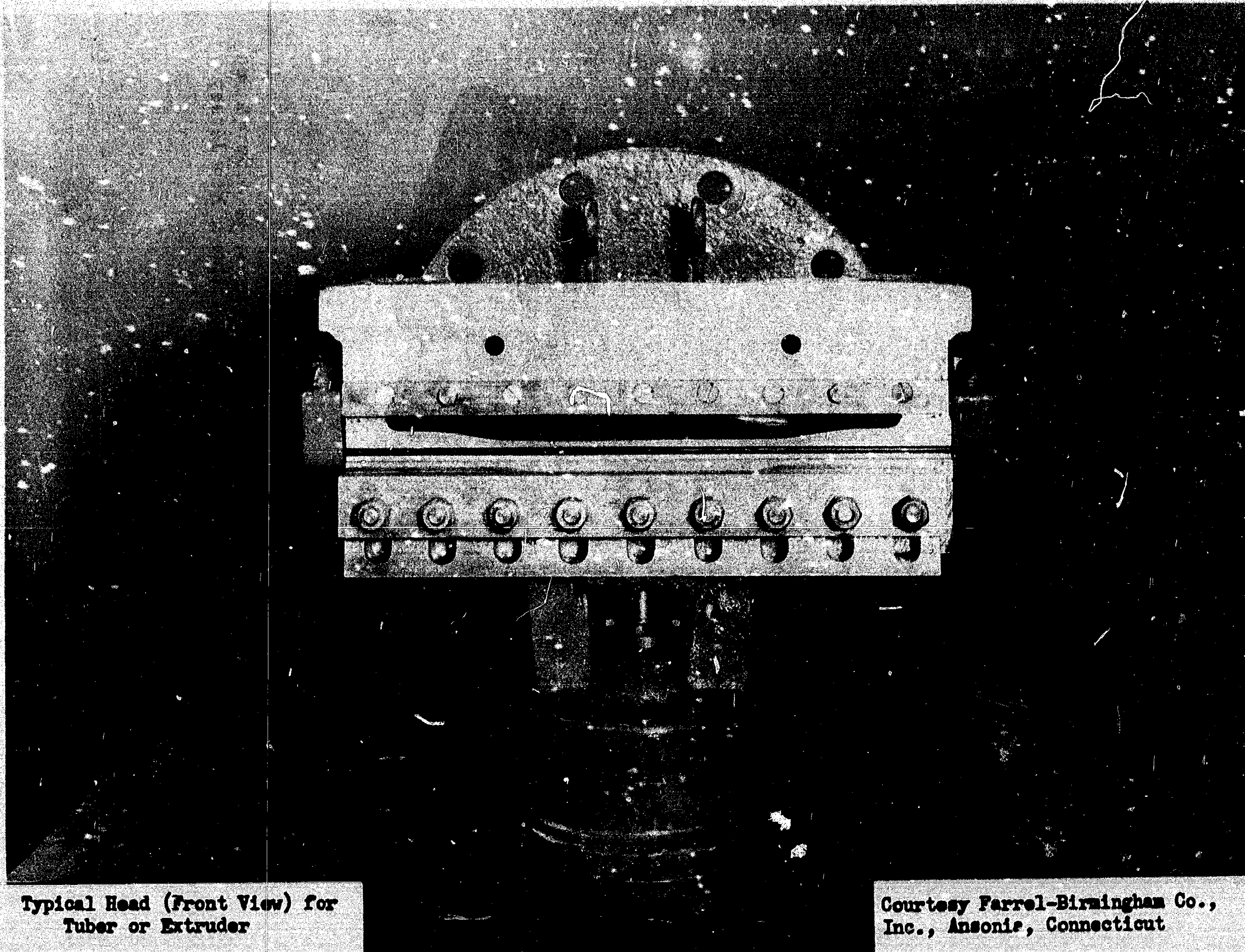


Figure 4

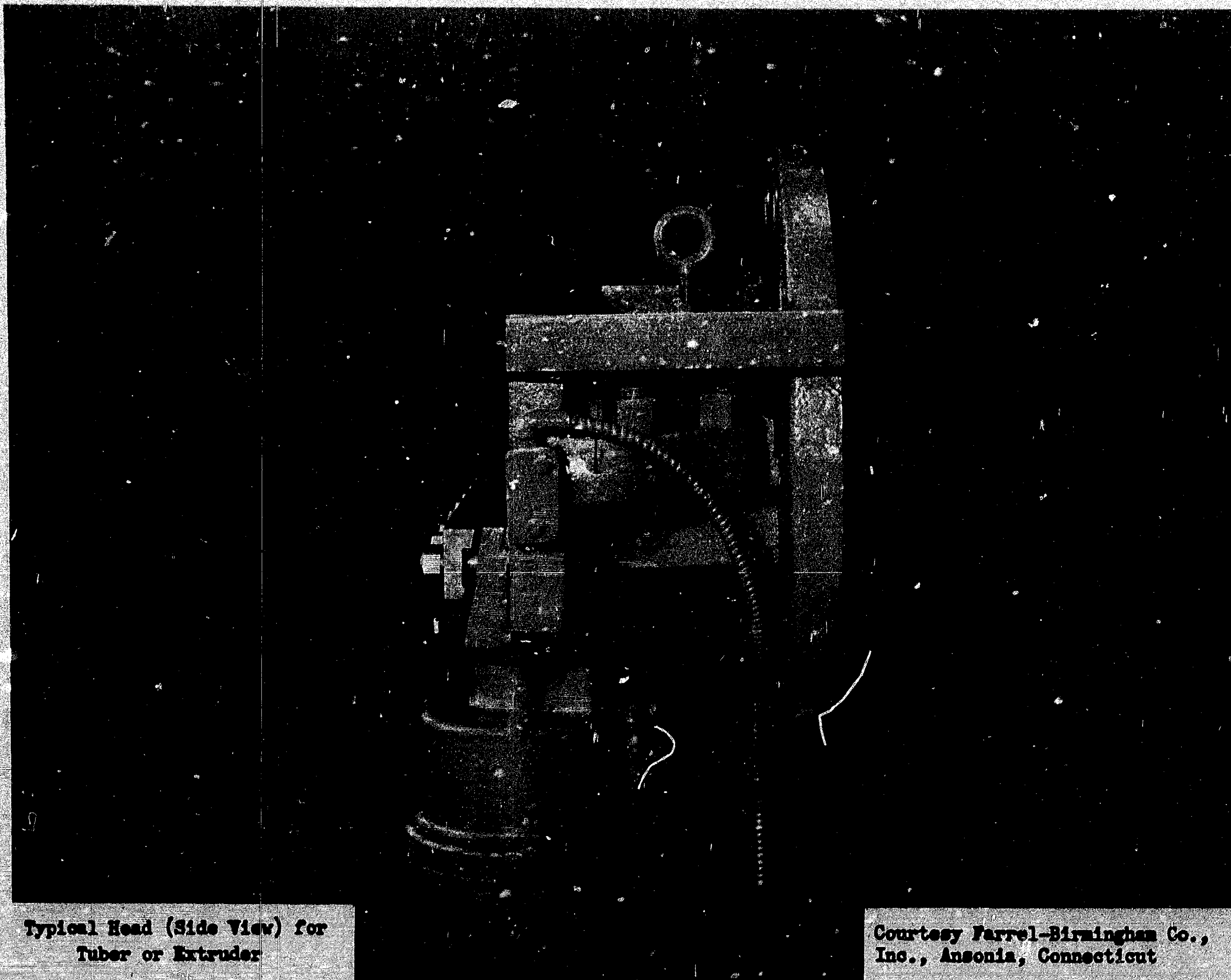
Tubing Machine, High Speed Type with Worm Drive

Courtesy L. Albert & Son
Trenton, New Jersey



Typical Head (Front View) for
Tuber or Extruder

Courtesy Farrel-Birmingham Co.,
Inc., Ansonia, Connecticut



Typical Head (Side View) for Tuber or Extruder

Courtesy Farrel-Birmingham Co., Inc., Ansonia, Connecticut