

67.06  
61  
**MINIMUM REQUIREMENTS  
FOR MANUFACTURE OF  
SHELL BUTTONS**

**SMALL INDUSTRY SERIES**

**DEPARTMENT OF STATE  
AGENCY FOR INTERNATIONAL DEVELOPMENT  
COMMUNICATIONS RESOURCES DIVISION**

**Washington 25, D. C.**



A.I.D.  
Reference Center  
Room 1656 NS

## FOREWORD

The purpose of this report is to present basic information for establishing and operating a plant to manufacture shell buttons in a country with a tropical or semi-tropical climate. The information includes general manufacturing methods, plant layout, and costs of materials, equipment, and labor based on the assumptions contained in this report.

The plant described is considered to be the economic minimum in size which utilizes suitable equipment and methods. Products are to be simple and varieties limited in order that costs may be kept to a minimum.

As an essential preliminary, potential plant operators must determine whether or not there is a market for the products of this plant. Naturally, they must be willing to assume the risks inherent in any business. The profits shown in the profit and loss statement are illustrative and depend upon market conditions, good management, and local factors.

For further information and assistance, readers should contact their local Productivity Center, Industrial Institute, Servicio, or United States Operations Mission.

This report is one of a series prepared for the Office of Industrial Resources of the INTERNATIONAL COOPERATION ADMINISTRATION by the Methods Engineering Council, Pittsburgh, Pennsylvania

July 1955



PLANT REQUIREMENTS  
FOR MANUFACTURE OF  
SHELL BUTTONS

INTRODUCTION:

Shell buttons are of two types:

1. Fresh water pearl buttons -- made from fresh water shells, and
2. Ocean pearl buttons -- made from ocean shells and trocas (snail).

Since ocean shells are apt to be more easily obtained and since there are no significant differences in manufacturing processes nor in the investment required, the plant discussed in this report manufactures ocean pearl buttons. Other raw materials from which buttons can be made are bone, horn, vegetable ivory, drum nuts, and plastics in sheet or rod form.

In the United States, nearly all pearl buttons are used in the shirt, blouse, and pajama industries. The most common sizes vary from 16 line to 36 line -- a line being 1/40 of an inch or .64 mm.

To facilitate conversion to local figures and costs, columns headed "actual" are included in the appropriate tables.

GENERAL ASSUMPTIONS:

In order to make realistic estimates, certain assumptions must be made. These are:

1. The costs of building, equipment, and material necessary are based on United States prices.
2. Labor costs used are the average for the industry and skill described, based on recently published figures of the United States Bureau of Labor Statistics.
3. All other costs, statistics, and figures are based on current United States prices.
4. Adequate heat, light, water, and electricity are available at the plant site.

5. Adequate transportation facilities are available at the plant site.
6. The plant operates on a 40-hour week -- a one-shift labor force.
7. No special provision is made for the training of new personnel. It is assumed that learner's rates will be paid in such cases.
8. The following items cannot be estimated realistically:
  - a. Distribution methods and selling costs
  - b. In-freight and out-freight
  - c. Land value
  - d. Taxes, insurance, and interest

Therefore, they are not included in the calculations except for general estimates in the working papers included in the appendices.

9. Each machine is set up to do one operation on one particular product most of the time. Apart from slight adjustments, no setup time is required and none is allowed in the unit cost calculations.

#### PRODUCT SPECIFICATIONS:

A realistic basis for beginning manufacturing would be to make natural color buttons with 16, 18, 20, 22, and 24 line diameters and an average thickness of 3 mm. Any style or design of a round button -- of which there are hundreds -- can be made. Three typical styles (enlarged size) are shown in figure 1.

It is assumed that the buttons will be sold to garment manufacturers and to wholesalers. (If buttons are to be sold to the retail trade, they should be put on cards.)

#### MANUFACTURING OPERATIONS:

The first operation in manufacturing shell buttons from ocean shells is the cutting of the blanks from the shell. This is done using an ocean pearl cutting lathe (figure 2). A highly skilled operator is required to perform this operation in order to obtain the maximum number of top grade buttons from the shells. A skilled operator should cut about 30 gross or 4,320 buttons per day.

Due to the variation in thickness of shells, it is necessary next to split the blanks into two or more blanks using a blank splitter. This is a simple, hand-operated device, but its efficient operation requires a highly skilled operator. The blanks are next classified as to thickness using a classifying machine (figure 3). The operation consists of placing the blanks in a hopper, and, after the machine has completed sorting them, removing the classified blanks. This requires only a low skilled person.

In the next operation the button blanks are ground to uniform thickness, and one side of the blanks is ground convex. This operation is performed on a convex grinder (figure 4). Since this machine is practically automatic, no high degree of skill is required of the operator.

The blanks are next faced or patterned (dished, ringed, or fish eyed) and the holes are drilled on an automatic facing and drilling machine (figure 5). This operation does not require a high degree of skill.

Once the cutting operations are completed the buttons are polished. This is done in a machine similar to a tumbling barrel (figure 6). The buttons are turned in the barrel with water and sulfuric acid for approximately 1 3/4 hours. After that they are washed in clean clear water, dumped back into the polishing machine and tumbled for about three minutes in a hot muriatic acid solution. The buttons are again washed in clear water. An unskilled employee can accomplish this operation satisfactorily.

The buttons are finally buffed to produce a high luster. A machine similar to that used in polishing is used. The buffing is done with a mixture of soft pine sawdust and gold dust washing powder. This operation requires about one hour and is not highly skilled.

Finished buttons are then sorted for size and quality on a sorting machine (figure 7) and packed for shipment.

#### MANUFACTURING UNIT USED:

The minimum economical size of manufacturing operation is based on using three automatic facing and drilling machines. Each machine has a capacity of about 200 gross (28,800 buttons) per day. Therefore, the plant is capable of a total daily output of 600 gross. Based on United States practices, production would be split by sizes over a week's cycle time approximately as follows:

<u>Line</u> <u>(1/40 Inch)</u>	<u>Percentage of</u> <u>Production</u>	<u>Gross</u> <u>Per Week</u>	<u>Actual</u>
16	20%	600	_____
18	40%	1200	_____
20	20%	600	_____
22	10%	300	_____
24	10%	300	_____
	<b>Total</b>	<b>3000</b>	_____

**DIRECT MATERIALS:**

The only direct materials needed are shells from which to cut the blanks and packaging materials. Ocean shell (from Australia) delivered in New York City sells from 35 cents to 92 cents per pound according to quality -- of which there are about five main grades. An average price is 75 cents per pound, and this is the price used in this report. Shells are usually received in wooden cases holding 250 pounds. It takes about one pound of shell to make one gross of buttons in the sizes specified. Therefore, 600 pounds of shells will be needed per day for a production of 600 gross. At \$.75 per pound the 600 pounds would cost \$450 per day.

The finished buttons are usually packed one gross per carton. Cartons and other packing materials would run about \$24 per day. Thus, the total cost of direct materials would be \$450 for shells plus \$24 for packing material, or \$474 per day.

**PRODUCTION TOOLS AND EQUIPMENT:**

Table I -- Machines and tools required

Description	Hours One Week's Prod.	Number Re-quired	In-stalled Price Each	Total In-stalled Price	Actual	
					In-stalled Price Each	Total In-stalled Price
Ocean pearl cutting lathe	800	20	\$ 230	\$4,600		
Blank splitting device	80	2	80	160		
Classifying machine	8	1	980	980		
Convex grinder	100	3	3,950	11,850		
Automatic facing and drilling machine	120	3	4,800	14,400		
Polishing machine	80	2	500	1,000		
Buffing churn	40	1	275	275		
Button sorting machine	40	1	1,100	1,100		
Attachments:						
Plate feeder (for grinders and automatics)	---	6	510	3,060		
Small fisheye (for automatics)	---	1	400	400		
Power equipment (including transmission shafting, shaft hangers, shaft-set collars, shaft couplings, pulleys, and necessary electric motors. Electric motors for each grinder and automatic would cost about \$350 apiece.)	---	--	---	10,000		

Table I -- Continued

Description	Hours One Week's Prod.	Number Re-quired	In-stalled Price Each	Total In-stalled Price	Actual	
					In-stalled Price Each	Total In-stalled Price
Containers (including 14 quart buckets, wash tubs or tanks, and earthen jars)	---	--	---	\$ 80	_____	_____
Miscellaneous (including facing tools and drills, chucks, saws, and weight scale)	---	--	---	2,500	_____	_____
Total				\$50,405	_____	_____

TOOLS AND EQUIPMENT OTHER THAN FOR PRODUCTION:

Table II -- Tools and equipment required other than for production

Description	Number Required	Price Each	Total Price	Actual	
				Price Each	Total Price
Dust exhauster	1	\$1,000	\$1,000	_____	_____
Shop tool grinding machine	1	160	160	_____	_____
Diamond wheel dresser	1	320	320	_____	_____
Mechanical dresser	1	160	160	_____	_____
Chuck turning lathe	1	600	600	_____	_____
Miscellaneous machine tools and equipment	--	---	850	_____	_____
Typewriter	1	150	150	_____	_____
Adding machine	1	125	125	_____	_____
Total			\$3,365	_____	_____

FURNITURE AND FIXTURES:

Table III -- Furniture and fixtures required

Description	Number Required	Price Each	Total Price	Actual	
				Price Each	Total Price
Bench 30' x 4' for blank cutting	1	\$100	100	_____	_____
Chairs	20	15	300	_____	_____
Filing cabinets	2	75	150	_____	_____
Desks and chairs	4	125	500	_____	_____
Total			\$1,050		

DIRECT LABOR:

<u>Operators</u>	<u>Number of Persons</u>	<u>Actual</u>
Lathe operators	20	_____
Blank splitting device operator	1	_____
Convex grinder machine operators	3	_____
Automatic facing and drilling machine operator	3	_____
Button sorting machine operator	1	_____
Material handler and tender for other equipment	2	_____
Total	30	_____

INDIRECT LABOR:

<u>Department</u>	<u>Number of Persons</u>	<u>Actual</u>
Receiving and Shipping	1	_____
Maintenance	2	_____
Office -- Clerical and Accounting	2	_____
Sales	(No figures)	_____
Manager, 1 Foreman	2	_____
Total	7	_____

**INVENTORY:**

The following inventory requirements are realistic:

Table IV -- Inventory requirements

Description	Number of Days	Value	Actual	
			Number of Days	Value
Direct materials (shells)	90	\$40,500	_____	_____
Work-in-process (Average 50% completion less packaging)	5	2,680	_____	_____
Finished goods	1 month	23,300	_____	_____
Total		\$66,480		_____

**PLANT LAYOUT:**

A building 30' x 70' (2100 square feet) should suffice for production purposes. In addition an overhead under which raw materials can be stored is needed. The overhead is separate because the shells have a strong odor. A preliminary layout is shown in figure 8.

**BUILDING:**

In the United States, the building, including plumbing, wiring, and dust ducts for the exhauster could be set up for about \$4.00 per square foot. This is for a structure which will meet minimum requirements -- for example: steel frame with sides of concrete block, concrete slabs, corrugated asbestos cement sheeting, or galvanized iron.

The overhead with a concrete floor could be put up for about \$1.50 per square foot. Total cost of building and overhead would be \$8,400 plus \$1,800 or \$10,200.

**PLANT SITE:**

There are no special requirements regarding the plant site -- only that it be located near suitable transportation, and within reasonable distances of raw material suppliers and button markets. The amount of land needed would be only about twice the size of the building -- enough for driveway, parking, and the like.

DEPRECIATION:

Table V -- Depreciation Schedule

Item	Actual Cost	Cost	Years' Life	Depreciation Per Year	Actual Depreciation Per Year
Building and overhead	_____	\$10,200	15	\$ 680	_____
Production equipment	_____				_____
Durable	_____	47,825	10	4,782	_____
Non-durable	_____	2,580	2	1,290	_____
Tools and equipment other than for production	_____	3,365	5	673	_____
Furniture and fixtures	_____	1,050	10	105	_____
Total				\$7,530 or approximately \$30 per day @ 250 working days per year	_____

OVERHEAD RATE:

Total overhead expenses can be estimated as follows:

Table VI -- Overhead calculations

Overhead Expenses	Estimated Cost Per Day	Actual Cost Per Day
Depreciation	\$ 30	_____
Indirect labor: 7 employees @ average of \$85 per week plus 4% for vacation = \$620 per week	124	_____
Power, light, and water	17	_____
Indirect materials for production, maintenance, repair, and office	6	_____
Insurance, taxes, and interest	No figures	_____
Total	\$177	_____

With 30 employees on direct labor there would be 240 direct labor hours per day. The overhead rate would then be:

$$\begin{aligned} \text{Overhead rate} &= \frac{\text{Total of daily overhead costs}}{\text{Total daily direct labor hours}} \\ &= \frac{\$177}{240} = \$.74 \text{ per direct labor working hour} \\ \text{Actual} &= \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \end{aligned}$$

**UNIT COST OF MANUFACTURING:**

In the United States the average rate of pay for direct employees in this business is \$1.70 per hour. Adding 4% for vacation pay makes an effective labor cost of \$1.77 per hour. For 30 employees at 8 hours per day this is a daily cost of \$425 for direct labor. Below is a summary of direct manufacturing costs.

Table VII -- Unit cost of manufacturing

Item	Estimated Cost		Actual Cost	
	Per Day	Per Gross	Per Day	Per Gross
Direct labor	\$425	\$ .71	_____	_____
Direct materials	474	.79	_____	_____
Overhead	177	.29		
Total		\$1.79		_____

**PROFIT CALCULATION:**

Prices at which a gross of buttons sells vary with the size and with the quality. Buttons with chips, spots, incomplete pattern and the like sell for less than first quality buttons. There may be as many as 12 to 18 degrees of quality. Prices will vary from \$.50 per gross for the poorest quality in the smallest size (considerably below cost) to \$3.50 for the best quality in the largest -- 24 line -- button. An 18 or 20 line first quality button would sell for about \$2.50 per gross. About 60% of the total production would get first quality prices. An average selling price for the buttons assumed in this report is \$2.37 per gross.

Selling and other costs represent about 20% of the manufacturing cost of shell buttons in the United States. This would include salesmen's commissions of about 5%.

Annual profit before taxes of between 10% to 20% of the capital investment is realistic. Representative figures are given in the working papers included in the appendices.

Generally United States manufacturers prefer to make a larger quantity at a lower profit margin as compared to setting a high profit margin which will result in lower quantity sold. This results in eventual larger profits for the manufacturers and raises the standard of living for more people on the whole.

WORKING CAPITAL:

		Value	
		<u>Estimated</u>	<u>Actual</u>
Direct material inventory -- 90 working days		\$40,500	
Work-in-process -- 5 days' production (50% completion)		2,680	
Finished goods -- one month's production		23,300	
Accounts receivable -- sale of one month's production		30,800	
Expenses for one month			
Wages	\$11,420		
Utilities	368	11,788	
Total working capital		\$109,068	

TOTAL CAPITAL REQUIREMENTS:

		Value	
		<u>Estimated</u>	<u>Actual</u>
Land		No figures	
Building		\$10,200	
Production tools and equipment		50,405	
Other tools and equipment		3,365	
Furniture and fixtures		1,050	
Working capital (excluding selling costs, taxes, insurance, and interest)		109,068	
Total		\$174,088	

## PROVISION FOR EXPANSION:

It is easy to expand facilities or to take on additional styles and sizes. The most logical way to diversify is to take on additional styles -- shapes such as oblong, square, hexagon, and octagon. It is also possible to make buttons out of other types of raw materials. It is advisable to keep the product and the product line as simple as feasible, however, in order to concentrate on production economies and to simplify the selling of the goods.

## SUMMARY:

This report indicates that a plant to manufacture shell buttons can be built and placed in operation with a total capital investment of about \$174,000. This plant would be capable of producing 600 gross buttons (86,400 buttons) per day or 150,000 gross (21,600,000 buttons) per year. Buttons would be round and of assorted sizes. Such a plant, if operated under the conditions specified herein, would produce an annual profit of about \$30,000 before taxes.

The plant would require a total force of 37 employees, including a manager and a foreman. While most of the personnel would not require specific prior training they would have to become skilled in the art of operating their equipment. This would particularly apply to the group of 20 employees who operate the lathes to cut blanks from the shells.

While buttons can be made from many different raw materials the process outlined in this report covers their manufacture from ocean shells. The availability and cost of this basic raw material (ocean shells) is an important factor in deciding the desirability of setting up such a plant. This report is based upon a consumption of 600 pounds of ocean shells per day, which can be acquired for a delivered cost of \$.75 per pound. This would be an annual consumption of 150,000 pounds, or 75 tons of shells.

---

Data used in this report were obtained from manufacturers of the equipment used to make buttons and from button manufacturers themselves. The latest advances in equipment and technology for making buttons were considered and specified when applicable. Those data, such as selling price, labor rates, other costs, and financial ratios conform to conditions current in the United States.

APPENDIX I - WORKING PAPERS - FIRST YEAR'S OPERATIONS

ASSETS	Pre-Operations Period		1st Quarter's Operations		Trial Balance		2nd Quarter's Operations		Trial Balance		3rd & 4th Quarters' Operations		Trial Balance End of Year		Manufacturing		Profit and Loss		Balance Sheet		
	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	
<b>Current Assets</b>																					
Cash	66,193		5,500	33,102	44,591		33,700	59,137	15,154		157,500	149,175	23,479							23,479	
Accounts Receivable			12,000		12,000		30,800	12,000	30,800		30,800	30,800								30,800	
Inventories - beg. of year																					
Raw Materials	40,500				40,500				40,500				40,500		40,500					40,500	
Work in Process																				2,680	
Finished Goods																				23,300	
Supplies	375				375				375				375		375					375	
<b>Fixed Assets</b>																					
Machinery	50,405				50,405				50,405				50,405		50,405					50,405	
Reserve for Depreciation												6,072	6,072								6,072
Furniture and Other Tools and Equipment	4,415				4,415				4,415				4,415		4,415					4,415	
Reserve for Depreciation												778	778								778
Building	10,200				10,200				10,200				10,200		10,200					10,200	
Reserve for Depreciation												680	680								680
Land																					
<b>Net Worth</b>																					
Capital Account		174,088				174,088				174,088				174,088							174,088
Surplus																					4,536
<b>OPERATING ACCOUNTS</b>																					
<b>Income</b>																					
Sales				17,500		17,500		52,500		70,000		157,500		227,500						227,500	
<b>Expenses</b>																					
Purchases													80,350		80,350						
Raw Materials			12,000		12,000		22,350		24,350		54,000		80,350		80,350						
Supplies							375		375		750		1,125		1,125						
Wages			17,400		17,400		27,500		44,900		66,500		113,400		113,400						
Light, Heat, & Power			1,062		1,062		1,062		2,124		2,125		4,249		4,249						
Selling & Other Expense			2,640		2,640		7,850		10,490		23,800		34,290		34,290					34,290	
General																					
Depreciation												7,530	7,530		7,530						
Administration																					
	\$174,088	\$174,088	\$50,602	\$50,602	\$191,588	\$191,588	\$123,637	\$123,637	\$244,088	\$244,088	\$345,005	\$345,005	\$409,118	\$409,118							
Inventories - end of year																					
Raw Materials																40,500					
Work in Process																2,680					
Finished Goods																				23,300	
Supplies																375					
Cost of Goods Manufactured																211,974		211,974			
																\$255,529		\$255,529			
Surplus																				4,536	
																				\$259,800	\$259,800
																				\$186,154	\$186,154

APPENDIX II - WORKING PAPERS - SECOND YEAR'S OPERATIONS

Assets	Balance Sheet Beginning of 2nd Year		Second Year's Operations		Trial Balance		Manufacturing		Profit and Loss		Balance Sheet End of Year	
	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit
<b>Current Assets</b>												
Cash	23,479		350,000	312,049	61,430							61,430
Accounts Receivable	30,800		30,800	30,800	30,800							30,800
Inventories - beg. of year												
Raw Materials	40,500				40,500		40,500					40,500
Work in Process	2,680				2,680		2,680					2,680
Finished Goods	23,300				23,300				23,300			23,300
Supplies	375				375		375					375
<b>Fixed Assets</b>												
Machinery	50,405				50,405							50,405
Reserve for Depreciation		6,072		6,072		12,144						12,144
Furniture, Other Tools, & Equipment	4,415				4,415							4,415
Reserve for Depreciation		778		778		1,556						1,556
Building	10,200				10,200							10,200
Reserve for Depreciation		680		680		1,360						1,360
Land												
<b>Net Worth</b>												
Capital Account		174,088				174,088						174,088
Surplus		4,536				4,536						34,957
<b>OPERATING ACCOUNTS</b>												
<b>Income</b>												
Sales				350,000		350,000				350,000		
<b>Expenses</b>												
Purchases												
Raw Materials			116,500		116,500		116,500					
Supplies			1,500		1,500		1,500					
Wages			137,000		137,000		137,000					
Heat, Light, and Power			4,249		4,249		4,249					
Selling and Other Expense			52,800		52,800				52,800			
General												
Depreciation			7,530		7,530		7,530					
Administration												
Inventories - End of Year	\$186,154	\$186,154	\$700,379	\$700,379	\$543,684	\$543,684						
Raw Materials							40,500					
Work in Process							2,680					
Finished Goods										23,300		
Supplies								375				
Cost of Goods Manufactured								266,779		266,779		
							\$310,334	\$310,334				
Surplus										30,421		
									\$373,300	\$373,300	\$224,105	\$224,105

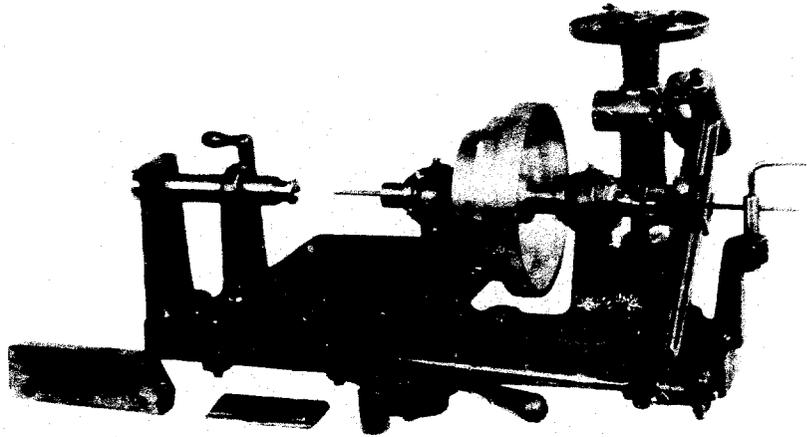


Figure 2 - Ocean pearl cutting lathe

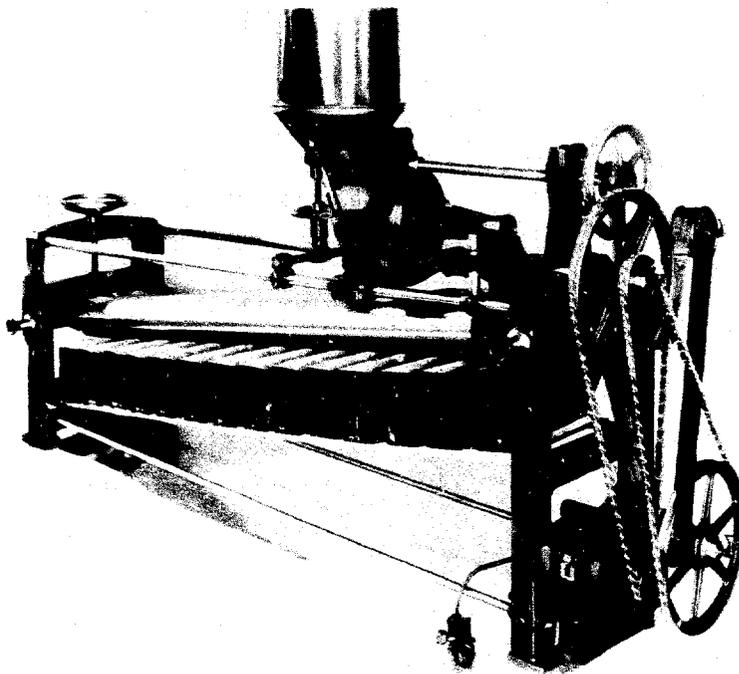


Figure 3 - Classifying machine

APPENDIX III - ILLUSTRATIONS:

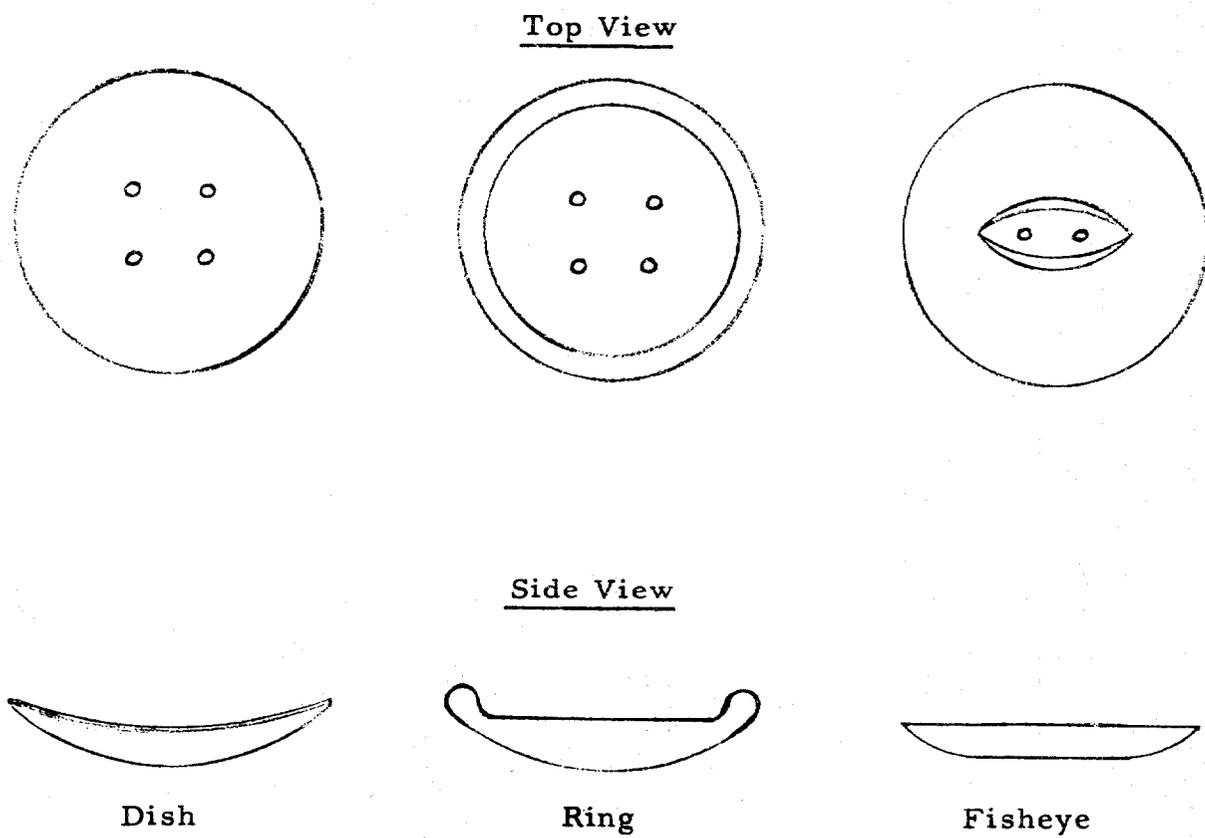


Figure 1 - Three styles of pearl buttons

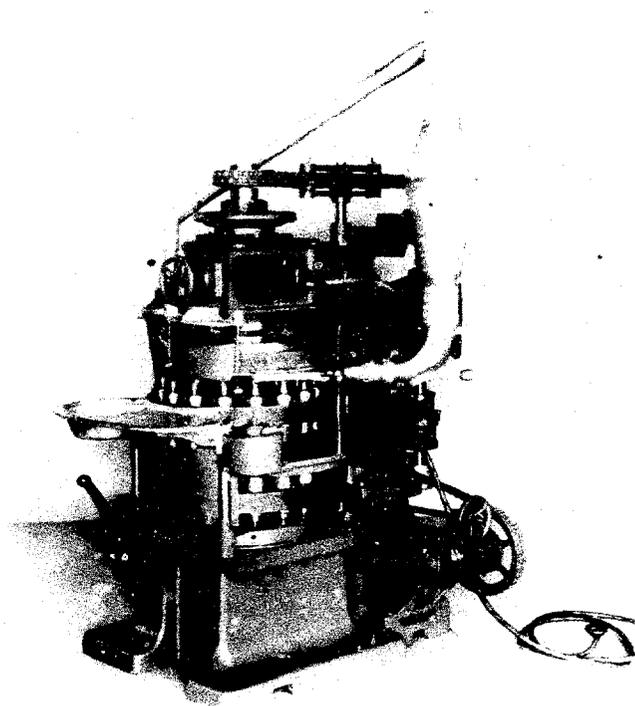


Figure 4 - Convex grinder or backing machine

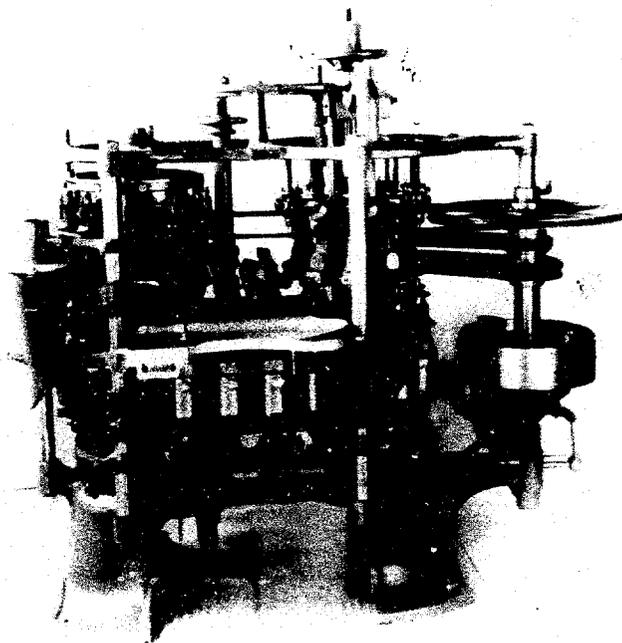


Figure 5 - Automatic facing and drilling machine

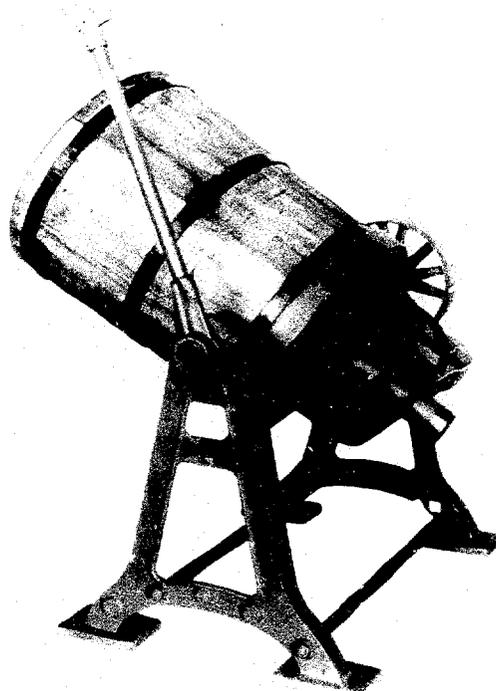


Figure 6 - Polishing machine

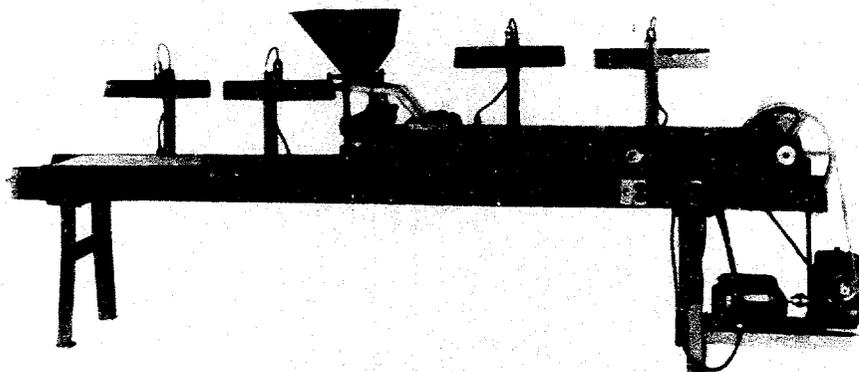
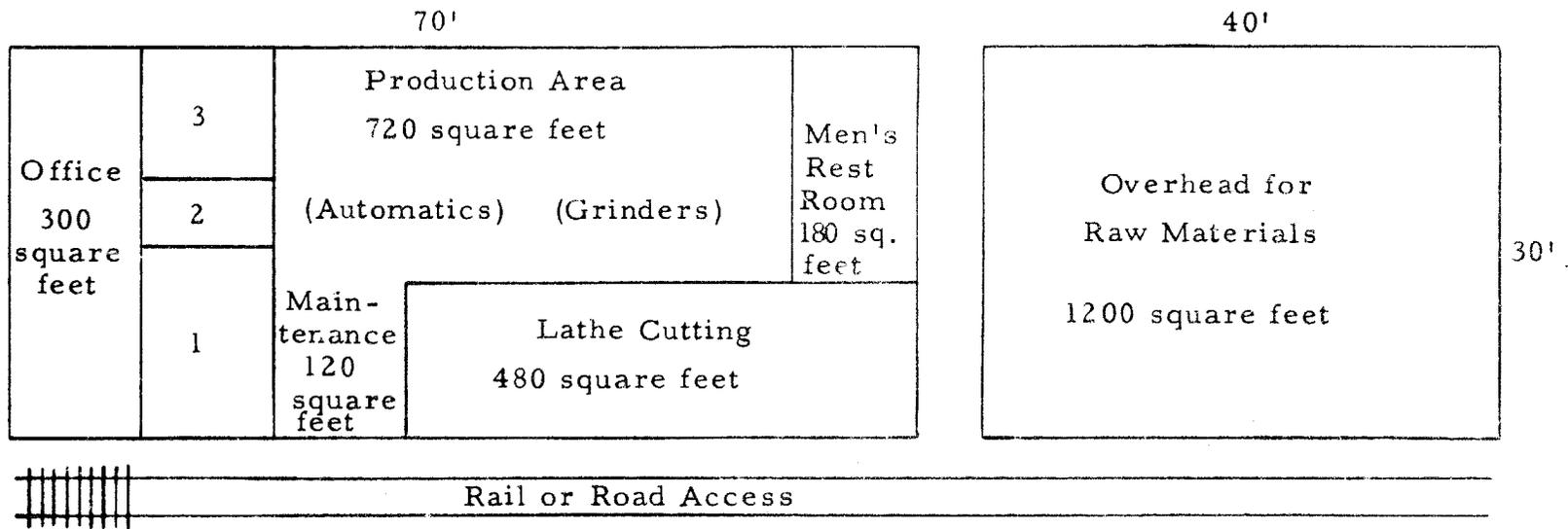


Figure 7 - Button conveying and sorting machine



Scale: 1" = 15'

Key

- 1. Shipping and Receiving -- 150 square feet
- 2. Finished Goods -- 50 square feet
- 3. Ladies' Rest Room -- 100 square feet

Figure 8 - Preliminary plant layout

## **PLANT REQUIREMENTS REPORTS AVAILABLE**

**ABRASIVE WHEELS  
ANIMAL FEED PELLETS  
ASBESTOS . CEMENT SIDING  
BRASS FOUNDRY  
BUCKETS, PAILS AND PANS  
BUILDING BRICKS  
BUILDING HARDWARE  
CERAMIC DINNERWARE  
COARSE WRAPPING PAPER  
CONCRETE BLOCKS & SLABS FOR WALLS  
COTTON DRESSES  
COTTONSEED OIL  
FARM HAND TOOLS  
FERTILIZER MIXING  
FIBRE BOXES  
FLAT GLASS  
GLASS CONTAINERS  
GRAY IRON JOBBING FOUNDRY  
JOB MACHINE SHOP  
KITCHEN EARTHENWARE  
LEATHER TANNING  
MEN'S HOSE  
MEN'S UNDERWEAR  
PAINT  
PAINT AND VARNISH BRUSHES  
PHOSPHATE PROCESSING  
PLASTICS MOULDING  
REFINED SUGAR  
SANITARY WARE  
SHELL BUTTONS  
TERRY CLOTH  
TWO-BURNER GAS PLATES  
WALLBOARD**