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PLANT REQUIREMENTS FOR MANUFACTURE OF BROOMS

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COMMUNICATIONS RESOURCES DIVISION
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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 May 1957 by Thompson and Williams, Pennsylvania Building, Washington 4, D. C., for the industry program through the facilities of the Office of Technical Services, U. S. Department of Commerce. Technical review was provided by Joseph L. Gillman Associates, Consulting Engineers, 1700 K Street, N. W., Washington 6, D. C.

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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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BROOMS

The following report describes plant operations based on:

1. Capacity of 600 brooms per day,

2. Eight-man labor force,

3. Single work shift, eight-hour day.

The reader is cautioned that the description is that of a plant of minimum size (simplest operation), based on the U.S. economy. It is obvious, therefore, that prices, wages, materials, and the manufacturing process itself may vary widely in other parts of the world.

The report is in no sense intended to supplant the actual financial survey or engineering methodology needed to establish a broom manufacturing plant in any country.

The manufacture of brooms offers a profitable business opportunity adaptable to broad variation in initial investment required, locale, raw materials, labor requirements, climate, and market conditions. Existing buildings may in many cases be adapted to house a modern broom factory with little or no alteration. The principal requirements are adequate floor space, a source of power, and ventilation. Fireproof buildings are desirable especially for warehousing space since fire insurance rates in many locations are high for any operation involving combustible materials.

Electric power is desirable for operation of machines in modern broom-making; however, engine-driven overhead shafts may be rigged. All operations can be accomplished on a small scale by hand where no source of power is available.

Provided a competent foreman is put in charge of a small factory, a large part of the work can be accomplished by unskilled labor. Only two of the 10 to 14 operations in broom making require the use of complex machines. Employees performing these two operations need about 30 days of specialized training, after which skill and speed are developed through on-the-job training. Other simple machine and hand operators can be trained on the job by the foreman. Many jobs can be handled equally well by men or women, making

the small broom factory an ideal single family or partnership venture. The universal demand for brooms makes this a steady business not affected by season, style changes, or economic conditions.

Initial investment for getting started in broom manufacturing is surprisingly low. A single family, using mostly hand operations and improvised equipment, may start a plant with virtually no capital investment except for initial raw materials. To set up a small, completely modern factory powered by electricity on a profitable scale with a capacity of 600 brooms per day would require an investment of about $15,000. A breakdown of cost estimates is given on page 6. Availability of materials and local market and labor conditions will govern the returns possible and, therefore, the minimum feasible investment.

Raw materials are generally available in some form. Broomcorn is by far the most popular of the brush materials, but numerous other fibers are used for specialized or cheaper brooms. Where local grasses or fibers are suitable, costly and complicated importing of materials can largely be eliminated since wood handles, tying wire, stitching twine, paint, labels, and broom crystals constitute the remaining needed materials and can for the most part be obtained nearby.

Local market conditions and requirements will, of course, influence types of brooms manufactured. All of the various classes and types of brooms using the various brush materials may be manufactured by similar methods using the same machinery. Large manufacturers usually make the various classes of brooms recognized by the trade, but small factories allow local market demands to control volume production and fabricate less frequently demanded classes on order.

THE FINISHED PRODUCT

Classes of brooms recognized by the trade are parlor brooms, carpet brooms, standard brooms, warehouse brooms, whisk brooms, and hearth or toy brooms.

Parlor Brooms. The best household brooms are made of select brush cured to retain its green color. This natural colored brush is selected for its smooth fiber and full tip. Center stems and coarse fibers are removed for use in cheaper brooms. Finished parlor brooms vary in length from 14 to 18 inches and in weight from 20 to 30 pounds per dozen.

Carpet Brooms are second quality household brooms made from brush that is rejected as "off" color for parlor brooms. They do not show the same finished quality as parlor brooms, although length and weight are the same and the brush must be full and smooth.

Standard Brooms are made from field-cured, off-color, or slightly damaged brush which has been rejected for use for parlor or carpet brooms. The brush is usually dyed to uniform green color using a solution of broom crystals in water. Finished broom size and weight is comparable to parlor and carpet brooms.

Warehouse Brooms are made for rough sweeping and special purposes. They are graded according to the kind of work for which they are intended -- smelter, railroad, deck, shop, etc. Some contain rattan or palmyra fibers, and stitching is of heavy material. Heavy metal bands are often used for one or more seams. Warehouse brooms vary in weight from 28 to 44 pounds per dozen and in length from 16 to 18 inches.

Whisk Brooms are usually made from brush that is shorter and finer than that used in parlor brooms. Although regular whisk brush may be purchased, this shorter brush may also be obtained by sorting from the regular stock of brush. Whisk brooms vary widely in finish, quality, length and price, though the present trend indicates a growing demand for large numbers of the cheaper quality.

Hearth or Toy Brooms may be made from the waste recovered from scrapers and shorter brush not usable in household brooms. They are of little importance commercially and are usually made on order.

RAW MATERIALS

Sources of the various raw materials mentioned in the following paragraphs are widespread and prices fluctuate rapidly depending upon local conditions. It is, therefore, recommended that prospective managers contact importers or consulates for complete information and current prices.

Brush. The most widely available fiber, and generally the best for most types of brooms, is obtained from broomcorn. This plant is grown in nearly all agricultural regions of the world. Some brooms are made from vegetable fibers such as palmyra stalks, rice straw, piassava (West Africa), "rice root", and even grass, sedge, and twigs in certain parts of the world. It is accepted practice to mix some of the cheaper, less desirable fiber with better grade fibers, particularly as inside fillers. Certain of the heavier, stronger fibers are chosen for warehouse brooms. Palmyra stalks (from palm trees of Ceylon and India) may be made into durable fibers that can be mixed with finer broomcorn fibers in a dual-purpose broom. A very strong, yet light broom is made from bassine fibers, which come from the feather-leaf palm trees of Central Africa.

The basic processes of broom manufacture are much the same for all types of fibers used, and the machinery described below can be adapted for making all types of brooms from all types of fibers. Regardless of the fiber selected, the manufacturer must obtain his supply in dry, reasonably clean condition, and of a quality suited to the market requirements of his area.

Synthetic fibers of nylon and plastic may be used, and local fibers may be adapted as a substitute.

Handles. Standard hardwood or fir handles for household brooms are available in 42 inch lengths and 7/8 to 1 1/8 inch diameters. For special purposes, handles may be larger or smaller, but all should be straight-grained and not warped. The finish should be smooth, so that the handle may be painted or

used with a natural finish. In the United States, broom manufacturers do not as a rule make their own handles. This simple operation is not described in this report. Local woods or bamboo are perfectly usable.

Wire. Winding machines are designed to apply a special wire under tension to secure the fibers to the handle. The wire recommended is 18-gauge soft steel, produced specially for broom manufacture.

Twine. Twine used in stitching the flattened brush after it is wound on the handle is of medium weight, waterproofed cotton or linen. The grade is variable according to the quality of the broom being manufactured. Since twine is one of the least expensive components of the finished broom, the manufacturer is advised to use a strong twine that will likely outlast the brush.

Paint. Most manufacturers paint their broom handles a variety of colors, preferably using a quick-drying lacquer. Besides making the finished product attractive, painting the handles improves their resistance to soiling and general wear.

Labels. Most manufacturers finish the broom by wrapping and gluing a label around the handle just above the wire winding. This serves the dual purpose of covering winding machine clamp marks and of identifying the broom with the manufacturer's name and perhaps an adopted name for the particular style of broom.

Broom Crystals. Most manufacturers dye the broomcorn fibers intended for the outside layers of the broom. The fibers may otherwise be somewhat discolored and spotty because of weathering, dust, etc. Dyeing gives the finished broom an attractive uniform appearance. The dye most frequently used is made by mixing broom crystals with water, preferably hot water.

PRODUCTION PROCESSES

The production processes in broom manufacture include sorting, evening, bundle-cutting, preliminary seeding and scraping, winding, final scraping and seeding, stitching, trimming, labeling, and bundling. Two other optional processes are handle painting and brush dyeing.

Sorting. Bales are stored in the manufacturer's warehouse from which they are removed one at a time to the sorting area. Here the bales are broken apart and bundles upended and placed on tables for sorting. Upending is necessary since bales are formed by placing alternate bundles together with the brush end in. Inferior quality brush -- that which is short, coarse, crooked, and off color -- is sorted from the finer quality which is reserved for use in household brooms. Sortings are used for whisk brooms, standard brooms, and toy brooms.

Brush Preparation. After the brush has been sorted, it is taken in bundles to the evener where it is bounced on the brush end until even. Bundles then go to the cut-off saw where the stem ends are cut leaving just enough stem to hold the fibers together. Bundle by bundle, the brush is then run through

the teeth of a drum-like scraper, stem end first, to break the straws apart and then brush end to remove the seed and the short loose straw. At this point, if the brush is off color, bundles are dipped in the dyeing vat to give the brush a green color. If top quality brush is used and needs no dyeing, it nevertheless needs to be damp when used by the winder. Since moistening is always desirable to make the brush pliable, and dyeing and bleaching are required for poorer grades of brush, it is advisable to set up in the factory a small area where bunches of brush dipped in the vats of water or dye may be allowed to drain. If bleaching is required to eliminate discoloration or stains, sulfur is burned in pots placed on the floor of an airtight room and the brush is exposed overnight to the sulfur dioxide fumes. Caution must be exercised here, since the fumes are noxious. Experienced personnel should handle this operation. Other methods of bleaching, using hydrogen peroxide, or chlorine-containing compounds, are found to be less hazardous.

Handle Painting. Handles, meanwhile, have been painted and allowed to drain and dry. This operation is accomplished by dipping in a specially prepared quick-drying lacquer. A device for quick and efficient handle painting can be fashioned from a length of 3" pipe fabricated into the shape of an inverted "h". To the top of the longer leg is fastened a retainer ring which holds a rubber gasket with a hole somewhat smaller than the diameter of the broomhandle. This length of pipe is sealed at the bottom leaving a depth for holding just enough paint to dip 38 inches of the 42 inch broom handle. Paint may be added to the necessary level through the opening of the other leg. The whole assembly is mounted securely atop a movable box or block.

Winding. Winding and binding of the brush on the handle is accomplished in modern factories by use of an electrically driven machine. As a first step, the handle is clamped into a Jacobs chuck which rotates as the operator applies the brush. About six inches of the handle is left projecting to receive the brush. One end of the broom wire, which is fed from a series of reels under tension, is inserted through a hole in the handle. A handful of brush, the fiber ends even, is applied around the end of the handle in layers and secured by causing the handle to rotate and wind the wire about the stem of the brush. The operator hammers the wire well into the stem as the handle rotates. Two small bunches of handle brush are next applied at opposite sides of the handle to start the flat shape of the broom. The part of the stem or brush above the wire is now cut off with a sharp knife and two additional handfuls of handle brush or "turnover" are applied to the shoulders with stem ends pointing toward the brush end of the broom. Several turns of the broom are made to secure the turnover and the two bunches are then turned over the wire so that the brush or fiber ends form the sweeping end of the broom. A string loop is then placed over the turnover to hold it in place while two coats of long select fiber or "hurl" are applied. The loop is then placed around all the fibers to hold them in shape until the broom is stitched. The broom is turned several times and the stem ends of the brush are tapered off with the knife and finally wrapped completely with wire which is broken or clipped and secured under a small nail driven into the handle. As the operator removes the broom from the winder, he raps the handle one time on an iron block to settle the brush and shape the shoulders of the broom. The finish for brooms varies widely; some are capped above the wire winding with a metal lock cap, others have velvet coatings covering the stem ends of the brush and wound under the wire, and still others are finished with wire wound neatly and tapering from the stem ends onto the handle of the broom.

Cleaning and Seeding. After winding, the broom fibers are given a final cleaning with the scraper or seeder. Holding the handle of the broom, the operator forces the brush into the teeth on the revolving drum of the seeder to remove loose straws and any seed that may remain on the brush. This operation, in effect, combs the broom clean, after which the string loop is replaced and the broom moved on to the stitcher.

Stitching. Stitching the broom is best accomplished by use of an automatic stitcher powered with a one horsepower electric motor. After replacing the twine loop about the brush with a leather strap, the broom is placed between the shaping jaws. One end of a length of linen or cotton waterproofed twine is inserted through the broom with a special hand tool and then is wrapped three times about the broom just above the jaws. The loose end of the twine is strung through the looper and the needle on the left hand side picks up the twine pulling it through above the three strand loop about the broom. The needle on the right picks up the thread and pulls it back through the broom below the loop forming the stitch and finally, the seam. This operation is repeated to produce the required numbers of seams. Broommakers generally agree that five seams are needed to produce the best quality brooms. Dangling threads are trimmed and the broom is finished except for clipping or trimming the sweeping end.

Trimming. The hand clipper consists of a heavy knife pivoted at one end to a frame which allows it to work as shears. The frame holds the broom in place and the clipper trims the broom squarely and evenly across, leaving as much of the fiber tips as possible.

Preparation for Shipping. Brooms are usually labeled with a printed gummed label placed over the portion of the handle showing winder clutch marks. The finished brooms are bunched in lots of a dozen, held together with sisal twine threaded through the brush with a bunching needle. Brown paper is wrapped about the bundle and the brooms are ready for shipping.

COSTS

Raw Materials		
Broomcorn Brush (depending on source and quality)	18¢ - 27¢ per lb.	
Handles	$1.10 per dozen	
Wire	$17.50 per 100 lbs.	
Stitching Twine	90¢ per lb.	
Bunching Twine	79¢ per lb.	
Labels	$1.50 per thousand	
Equipment		$5,165 - $6,585
Stitcher	$2,800 - $3,400	
Winder	700 - 900	
Hand Clipper	35 - 45	
Bundle Cutter	600 - 700	
Scraper or Seeder	400 - 500	
Hand Tools (set of trimming knives, bundling needles, etc.)	30 - 40	
Tables, Bins and Racks	600 - 1,000	

Building and Land	$9,000 - $13,000
Total Initial Investment	$14,165 - $19,585

Personnel (Eight man force)		$26,800 per annum
Foreman	$5,200	
Winder (2 @ $3,200 - $3,800)	7,000	
Stitcher Operator	3,800	
*Sorter	2,600	
*Evener and Bundle Cutter Operator	3,000	
*Scraper Operator (also does bleaching and dyeing)	2,800	
*Laborer, handle painter	2,400	

* These will not be full-time operations in a minimum size broom factory, and these men will perform additional part-time duties such as trimming finished brooms, labeling, bundling, shipping, and clean-up.

Operating Capital Estimate. An estimate of the capital required for three months at a production rate of 600 brooms per day is as follows:

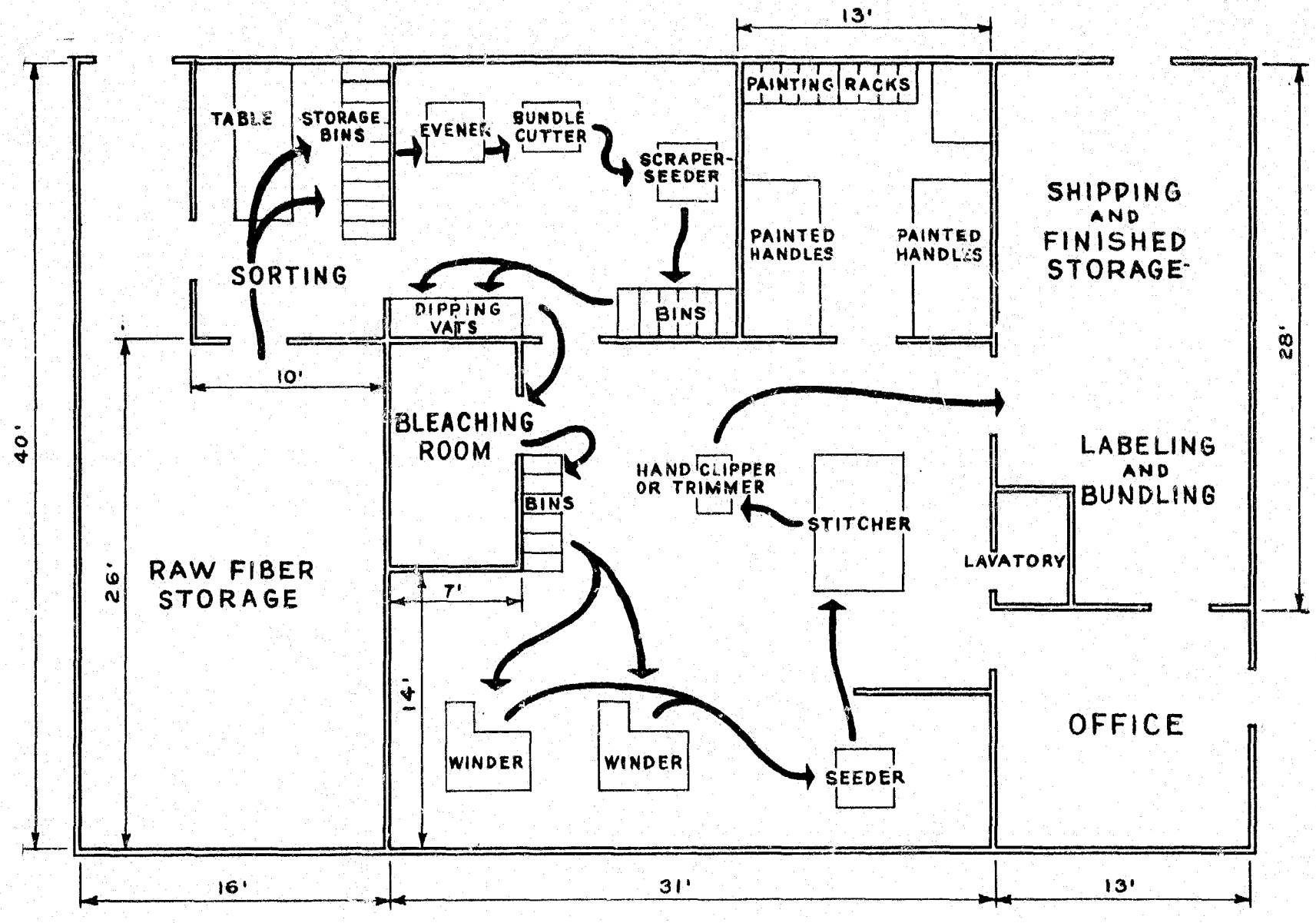
Broomcorn @ 20¢ per lb., 20 lbs. per dozen	$13,000
Handles @ $1.10 per dozen	3,575
Wire @ $17.50 per 100 lbs.	455
Miscellaneous (includes binding twine, broom crystals, bundling cord, brown paper, wrappers, labels, etc.)	250
Office Supplies and Expenses	100
Personnel	6,700
Rent	450
Insurance	150
Trucking	80
Depreciation on Equipment @ 5%	260
Utilities	150
Repairs	200
Contingencies	300
	$25,670
Sales of 39000 brooms @ 75¢ each	$29,250

Working capital, after initial investment is made and the plant is in continuous operation, may be estimated at 20% of expected sales for a given period.

Allowance is not made for a continuing inventory of raw materials and finished brooms.

Accounting methods and accounting forms can be found in any textbook on Cost Accounting or Industrial Accounting.

There are no specific forms used in production or quality control of brooms. This is a simple duty assigned to the foreman, whose inspection is visual.



PLANT LAYOUT AND WORK-FLOW CHART
FOR MANUFACTURE OF BROOMS

Catalogs and maintenance and operation manuals for broom making machinery are available from all of the manufacturers listed on the following pages on request.

Acknowledgment. Special acknowledgment is extended Mr. Charles McCaffray and his staff of The Baltimore Broom Machine Company, 2800 Sisson Street, Baltimore 11, Maryland, for technical assistance to the authors in gathering data for this presentation; this assistance extended beyond broom machinery itself to the full range of the broom industry.

Acknowledgment is also given Messers Andrew Meyers and Andrew Dotterweich, Stenger Broom Company, 3412-28 Pulaski Highway, Baltimore 24, Maryland, for demonstrations and technical data furnished the authors, especially for the section of this paper dealing with the production processes.

SOURCES OF MATERIALS AND EQUIPMENT

The following lists are not intended to be exhaustive, but rather to indicate enough major suppliers so that anyone interested in establishing a broom factory can obtain needed information directly from suppliers. Only United States suppliers are listed. It is suggested that managers of new plants in foreign countries may obtain information concerning sources of supply in other countries through appropriate importers or consulates.

Broom Crystals

New York Color and Chemical Co.
Main and Joralemon Streets
Belleville 9, New Jersey

Broom Labels

Cullen Broom and Mop Co.
Helmsburg, Indiana

Broom Machinery

Baltimore Broom Machine Co.
2800 Sisson Street
Baltimore 11, Maryland

C. Brooks Harryman
1436-42 Fleet Street
Baltimore 31, Maryland

Johnson Equipment Co.
P. O. Box 88
Wichita, Kansas

St. Louis Broom Supply Co.
5030 N. 2nd Street
St. Louis 7, Missouri

Broom Handles

St. Helens Wood Products Co.
St. Helens, Oregon

Temple-White Co., Inc.
Diboll, Texas

Washington Handle Co.
P. O. Box 975
Coos Bay, Oregon

The Gateway Corp.
100 Fifth Street
P. O. Box 908
Corinth, Mississippi

Broom Wire

Seneca Wire and Manufacturing Co.
Fostoria, Ohio

Madison Wire Co., Inc.
South Park
Buffalo, New York

Broom Twine

The Linden Thread Co., Inc.
418 Grand Street
Patterson 1, New Jersey

Bob Stone Cordage Co.
Chariton, Iowa

The Nitram Manufacturing Co.
47 Long Street
East Orange, New Jersey

Lacquer

Chas. D. Denning
3194 Work Road
Cincinnati, Ohio

Sterling Lacquer Manufacturing Co.
St. Louis 3, Missouri

Broomcorn Seed

Franklin Broomcorn Co.
Franklin, Tennessee

George L. Pfeifer
Arcola, Illinois

Broom Caps

The Cly-del Manufacturing Co., Inc.
16 Cherry Avenue
Waterbury 6, Connecticut

Line Novelty Manufacturing Co.
P. O. Box 1386
Waterbury 63, Connecticut

Broom Tools

C. D. Dickinson & Son
North Hadley, Massachusetts

C. Brooks Harryman
1436-42 Fleet Street
Baltimore 31, Maryland

St. Louis Broom Supply Co.
5040 N. Second Street
St. Louis 7, Missouri

Broomcorn Fibers

The Thomas Monahan Co.
Arcola, Illinois

South Texas Broom Corn Co.
Beeville, Texas

G. Fred Williams
P. O. Box 2111
Wichita 1, Kansas

H. L. Ginns, Broom Corn Co.
546 Commerce Street
Wichita, Kansas

Ingle Brothers
North Kansas City, Missouri

John Morrison & Sons
Lindsay, Oklahoma

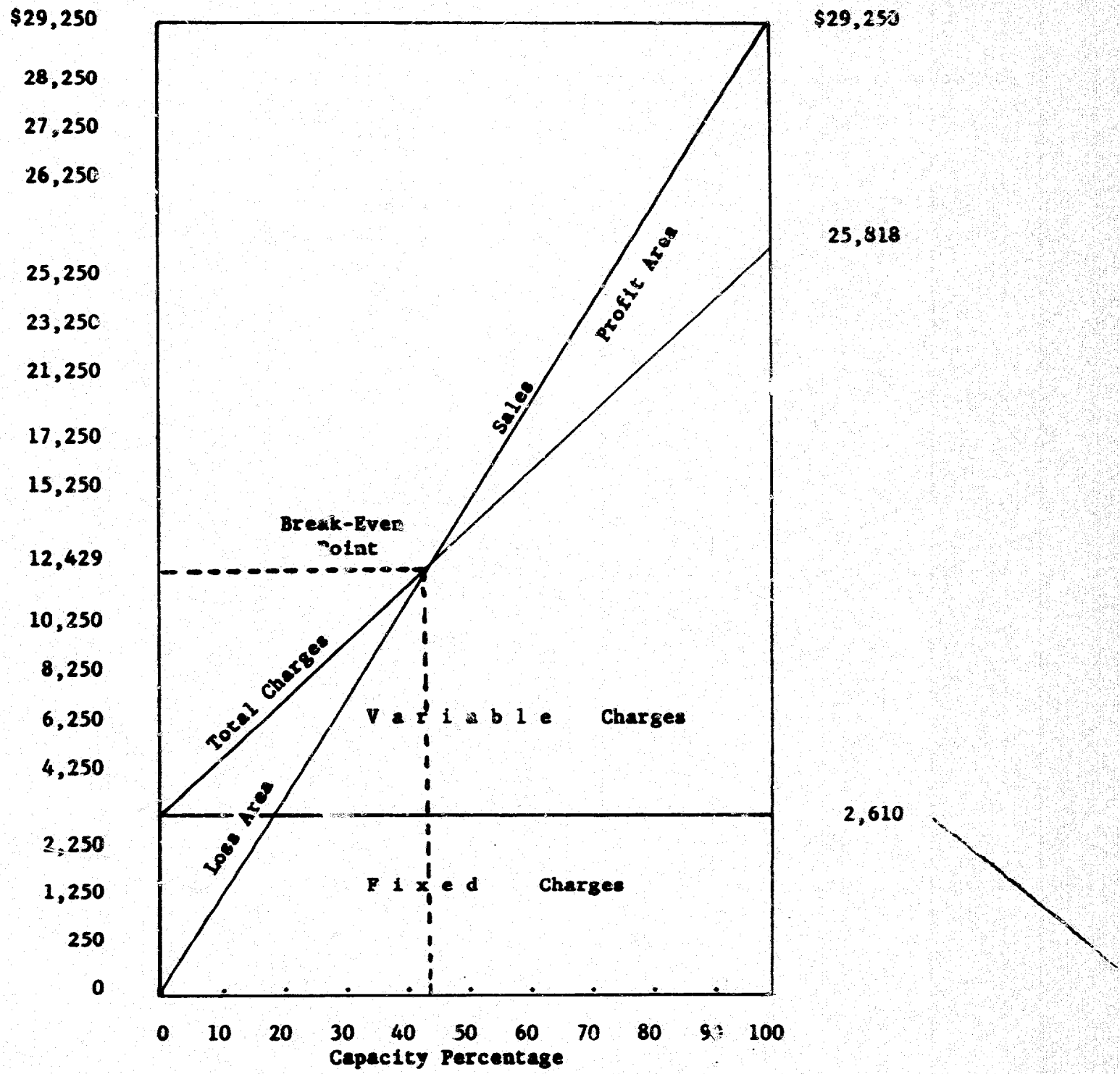
John L. Denning & Co., Inc.
Wichita, Kansas

Charles H. Demarest, Inc.
227-9 Water Street
New York 38, New York

Central Broom Supply Co.
2250 South Halsted
Chicago, Illinois

A. A. Huegler & Sons
Beeville, Texas

BREAK-EVEN ANALYSIS FOR BROOM MANUFACTURING



1. Total fixed charges are $2,610.

2. Variable charges are 79% of sales.

3. The sale price of units, assuming full production, is $29,250.

Break Even Chart by
Schumaker and Yates
Certified Public Accountants
1511 K Street, N. W.
Washington 6, D. C.

BIBLIOGRAPHY AND SOURCES OF INFORMATION

National Broom Manufacturing and Allied Industries Association, Arcola, Illinois; Paul Lindenmeyer, Secretary

Broomcorn Growing and Handling, U. S. Department of Agriculture, Farmers' Bulletin No. 1631, by John H. Martin and R. S. Washburn. For sale by Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 15¢, 36 pages, reprinted 1951

Economic Botany, Vol. 7, No. 2, April-June 1953, pages 163-181, Broomcorn -- The Frontiersman's Cash Crop, John H. Martin, Senior Agronomist, U. S. Department of Agriculture

Broom and Broomcorn News; issued weekly, Arcola, Illinois; subscription -- U. S., $6.00 per year; foreign, $7.00 per year. Paul A. Lindenmeyer, Editor and Publisher

Consultants

Columbia Consultants
Barrister Building
Washington 4, D. C.

Methods Engineering Council
718 Wallace Avenue
Pittsburgh 21, Pennsylvania

Ebasco Services, Inc.
Two Rector Street
New York 6, New York

Morris and Van Wormer
25 Broad Street
New York 4, New York

Bruce Payne & Associates, Inc.
1 Avery Place
Westport 1, Connecticut

Stevenson, Jordan & Harrison, Inc.
19 West 44th Street
New York 36, New York

Albert Ramond and Associates, Inc.
1615 Tribune Tower
Chicago 11, Illinois

Booz, Allen and Hamilton International, Ltd.
1625 Eye Street, N.W.
Washington 6, D. C.

Council for Economic and Industry Research, Inc.
734 15th Street, N. W.
Washington, D. C.