PLANT REQUIREMENTS FOR MANUFACTURE OF HARDWOOD PARQUET FLOORS

DEPARTMENT OF STATE
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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.

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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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Hardwood Parquet Flooring

INQUIRY: Request for information on practical layout for a complete plant from the sawmill to the finished product.

INFORMATION SUBMITTED:

INTRODUCTION: The manufacture of parquet flooring in the United States is confined to a few large shops which have spent a considerable amount of money and time in experiments with wood drying, grain selection, and in designing and building special equipment for machining and joining of small wooden parts into durable blocks of the required squareness and accuracy. In addition, parquetry manufacture requires a high degree of alertness to compete against other floor styles. Also, considerable skill and experience must be acquired in fashioning the best patterns of parquetry possible from the available material.

MANUFACTURING PROBLEMS INVOLVED: The inquiry at hand calls for a daily production of 600 blocks in three distinct styles as shown on the floor plan. For this limited daily output, the following traditional methods of parquet flooring manufacture are presented, with a layout showing the flow of the entire manufacturing process. The various operational techniques are explained. Certain recommendations are made for producing with some degree of mechanization including some automatic feeding. This enables the shop to produce 12 inch blocks accurately and of pleasing designs, and to do so with the least number of skilled operators. Operational sequence in such a shop is as follows: Sawing the log into planks, ripsawing the planks into boards, cutting out the faults, air and kiln drying the selected boards, planing and joining the boards, tenoning the ends, gluing and finishing the blocks and finally, bundling and packaging according to pattern and storing.

MANUFACTURING DETAILS:

1. Sawing the Logs: The logs, 12-30" in diameter, are drawn from the storage pond to the mill floor on the log slip (item 1).* From the log slip, the log is put on the log carriage (item 2) and sawed into planks, and turned whenever needed for better grain selection by the two men indicated. The saw to cut the planks from the log in this case is a 60" circular saw (item 3).

The planks so produced are next rolled over a table (item 4) and fed through the multiple circular saw which cuts them into boards of the desired width (item 5).

*See Floor Plan - Page 11

The scrap, that is, the two tough edges cut from the planks are piled on a hand truck and reduced to short lengths by a slash and used as fuel for the steam boiler that drives the log saw.

The importance of ripsawing becomes plain when it is understood that the selection of widths and the amount of usable material taken from each plank of the log depends entirely upon this process. A ripsawyer is charged with cutting lumber stock to best advantage with respect to the widths afforded by each individual plank. For this purpose the machine, a gang ripsaw, is equipped with as many as five saws, readily adjustable to various widths so that as many as five cuts may be taken at one pass through the machine.

ROUGH PLANING: Upon leaving the ripsaw, the boards are piled up on hand trucks and then fed through a double-head planer for prefinishing the two faces (item 6).

OPEN AIR DRYING: The boards so planed are now piled on hand trucks and pushed over rails to the open-air dryer (item 7) where they are kept from 30 to 60 days, to reduce moisture content to about 40 per cent. After this preliminary drying, some lumber operators in the tropics treat the boards with approved fungicides and insecticides to prevent sap-strain, insect and termite attacks and tropical rot.

KILN DRYING: This next operation requires great skill, experience and judgment since only a properly dried raw lumber will resist shrinkage, cracking, warping or buckling, after it has been made into the finished parquetry squares.

Proper kiln-drying is not simple. Its purpose, of course, is to eliminate most of the moisture still in the lumber. All wood expands with an increase in moisture content, then correspondingly contracts when the moisture content is lowered. There is a top limit for this expansion - the saturation point of the wood fibre - and a bottom point at which the wood contains practically no moisture at all. Both extremes are equally undesirable for flooring, which according to standard practice should be manufactured from lumber containing only 6-9 per cent moisture. This has been determined as the average moisture content for tropical and semi-tropical climates.

The air-dried lumber is carefully stacked in bunks and rolled into the dry kiln (item 8). This is a long, low building somewhat resembling a single-story warehouse, with heavy doors at both ends. At the entrance, or the "charge" end, the air is relatively high in moisture content but the temperature is held fairly low. The boards are moved at an established rate through the building, the moisture of the air is dropped sharply and the temperature is correspondingly increased. These conditions of moisture and temperature are so adjusted that the moisture from each board evaporates only as fast as it reaches the surfaces of each board. Thus, the drying process is not forced, for under conditions of too-quick evaporation many kinds of hardwoods tend to caseharden, honey-comb check and split.

Heat for the evaporation of moisture within the wood is provided in most kilns by steam coils beneath the bunks automatically controlled. The necessary circulation of air within the kiln itself comes from a natural draft through a centrally located flue, with the rising heat providing the draft, or from forced circulation by high ventilation fans, the air current being regularly reversed.

The length of time needed to kiln-dry a single bundle of hardwood lumber and kind of circulation used is determined by three factors: (1) the kind of lumber sawed, (2) its moisture content, and (3) the thickness of the boards. The customary period is about four days in forced air kilns and eight to nine days in kilns utilizing natural draft circulation. But the actual time for each load can only be established by the trial and error method. The checking is done by a short sample strip inserted in each pile and examined at various stages of the drying operation, and tested for an accurate check on the progress of the drying. This is done by weighing the sample strip and checking its weight with the weight of a piece of the same size having a known, correct moisture content. Loading and unloading is done manually, with the loading of the kiln trucks taking place nearest to the planing machine.

Upon leaving the kiln, the dry lumber is placed in cooling sheds for a minimum of 48 hours before being subjected to further machining. During this period, the lumber cools to atmospheric temperature in a leisurely manner, thus equalizing the moisture content of each board from its center outward and relieving inward stresses that might cause distortion after manufacturing processes are completed.

Upon leaving the cooling shed, the dried boards are taken to a sorting place where all imperfections are cut out on a simple handfed cross-cut saw (item 10). The useable boards are then piled back on the hand trucks according to grain structure and moved in front of the planer-matcher.

PLANING AND MATCHING: The machine (item 11) is equipped with a top and bottom cylinder for final surfacing of the top and bottom faces of the boards as well as with two vertical side spindles to cut the tongues and grooves on the edges.

CUTTING TO SIZE AND CLASSIFYING GRAIN: Next, the stock is cut to the desired short lengths on a small circular saw table (item 12) and as the short pieces fall from the saw onto a grading table, one or two men inspect each individual piece for grain structure and size. After careful inspection each piece is tossed into the proper bin.

END MATCHING AND GLUING: The end matcher, also called the double-end tennoner, cuts the tongues and grooves on the ends of the short pieces and/or on the ends as well as the sides of the finished blocks.

Care and skill in operating this machine is unusually important since the end joints must fit perfectly on a smooth floor. After the pieces have been carefully inspected, gaged, and selected according to their grain

structure, they are taken from the bins on small hand trucks to the end matcher (item 13) and then to the gluing table (item 14).

If style 2 is being manufactured, all short boards go from the end matched directly to the gluing table. However, if style 3 is being produced, the very short block in the center must be first machined on all 4 sides before being taken to the glue man.

SANDING THE BLOCKS: After the blocks have been glued, and the glue has thoroughly dried, they are ready for sanding. This finishing operation for the small daily output required, can be done on an endless belt sander (item 15). On such a machine, the workman can soon acquire the necessary touch to apply the pressure needed on the pad of the machine to produce a fine surface finish and bring out the natural beauty of the flooring by revealing the grain. The latter is only possible if a careful selection of the short pieces was made at the bins.

PROTECTING THE SANDED SURFACES: By the use of appropriate finishing materials and methods, the sanded surfaces are provided with protection against moisture and air impurities (item 16). All wood dust is swept away from the sanded surfaces and a durable coating as a final finish is applied to the blocks when laid down on the floor to withstand the grueling punishment of being scuffed and ground underfoot.

SURFACE FINISHES: This may be a varnish, shellac, or a lacquer finish.

Varnish finished: Finishes made from natural gums, such as amber or kauri heated in linseed or tung oils with driers and thinners added, are called oleo-resinous varnishes. Synthetic gums or resins are now used to replace the natural gums, giving the modern "phenolic", "synthetic" or "plastic" finishes. These synthetics are varnishes that are durable, flexible, light in color and resistant to chemical and physical agents. Without further processing, floor varnishes are generally sold to the trade as seal or sealer, surface seal and finish and spar varnish.

Penetrating synthetic sealers require hours to dry and the instructions of the manufacturer should be carefully followed.

Shellac is a popular wood floor coating since it generally dries in half an hour or less.

Lacquers: These solvents evaporate very quickly and leave a celluloid film. No additional rubbing or polishing is recommended (item 15).

TOOL ROOM REQUIREMENTS: A well equipped tool sharpening shop (item 17) is recognized as the most vital adjunct in the proper maintenance of all cutting equipment. For this naturally certain details will have to be worked out locally and a toolman must be employed who is generally familiar with the sawing and other machining operations in hardwood and he can adjust the grinding equipment to the correct tool curring angles, chip clearances and other requirements for smooth cutting operations.

INSPECTION: One further aspect of parquetry production must be emphasized.

Virtually every step in the production of block parquetry from sawing the logs to the final finish of the square blocks is constantly checked for accuracy and acceptable grain quality. This can be done only by a master foreman, who is an inspector, who must watch the drying process. He must use his gage to measure the sizes of the tongues and grooves; he must see that the various sizes of parquetry parts are laid so that they present the most pleasing effect. He should have enough bins near the cuttings for the proper separation not only of sizes but of grains in each size. The periodical inspection of the various parts piled up in the numerous bins will enable him to guage the cutting operations performed on the various machines and as soon as any inaccuracy appears on any of the material, he must be able to make the necessary adjustment on the machine. He should be familiar with certain safety measures required to protect the men working on these high-speed woodworking machines and be able to enforce strict observance.

LABOR REQUIREMENTS: The entire flow of manufacture is so geared that comparatively few workers are needed. The breakdown of the entire process into numerous details make it possible to use semi-skilled men, who may be otherwise totally inexperienced in any craft but each able to perform his work after only a brief period of training.

Great importance should be attached, however, to the employ of the four men indicated on the layout on page 11. These are the men alongside the saw, one man near the bin for inspecting the semi-finished products, the tool-grinder in the tool room, and finally the general foreman who watches the entire production process.

FLOW CHART: A tentative flow diagram is submitted on page 11 indicating the location of each machine in reference to the operation it performs. Sufficient space should be allowed for ample elbow room around the machines for the operators, as well as for the movement of the work and for the disposal of scrap.

WASTE REMOVAL: This is essential for a smooth work flow. Waste from the sawmill should fall clear for easy removal by hand trucks, taking the waste straight out of the building for burning in the handfeed boiler.

To take care of the chips and sawdust, proper installation of a ductwork is recommended. This can be made locally.

COST OF MACHINERY AND TOOLS

ITEM		
1-3	Small sawmill, including carriage, rails, log holders, log setting and adjusting mechanism, carriage advance and reverse, 60" circular saw; equipment capable of sawing logs max. 20' long and 30" diameter, receiving power from boiler-engine combination. (HP required about 25. Space required about 80' by 12').	$ 3,250.00
4	Drop table frame to receive sawed planks	200.00
5	Circular saw to ripsaw planks into narrow boards with five circular saws, 12" each, with quick adjustment from stand of operator. (HP required about 6. Space required about 8' by 22').	2,250.00
6	Plain, double surface planer with 2 cylinder heads, for rough planing of narrow boards. (HP required about 5. Space required about 8' by 8').	1,200.00
7	Open air drier racks	200.00
8	Dry kiln parts, including heating pipes, fin pipes for heat dissipation, heating and temperature controls, doors, valves, racks, blower and blower connections, roof ventilators, moisture meter, air circulation equipment for automatic reverse flow of air, erection plans for building, but no building or foundation work included, sufficient space and capacity to accomodate 4000 to 5000 feet of lumber, board measure, space required about 45' by 12'.	3,800.00
8a	Cooling shed racks	200.00
9	Sorting tables, gages, frames	200.00
10	Planer and matcher, to take boards to 10" width, with one set of planer knives for upper and lower cylinder, and one set of T.& G. matcher heads with a set of T. & G. knives, including transmission for pulley drive. (HP required about 12, space required about 14' by 6').	2,200.00
11	Circular table-saw to trim long boards into short lengths and to cut off undesirable spots on boards. (HP required about 3. Space required about 4' by 4')	200.00
12	Grading tables	200.00
13	End matcher, also called tennoner, to provide short lengths from 4" to 12" with T.& G. on their ends prior to assembly into 12" blocks. (HP required about 8. Space required about 8' by 4').	1,250.00

ITEM		
14	Gluing - table and glues	400.00
15	Belt sander, to sandpaper the finished blocks on their top faces. (HP required about 4. Space required about 10' by 4').	850.00
16	Varnishing, shellacing and/or lacquering tables	200.00
	TOTAL	16,400.00

TOOL ROOM REQUIREMENTS

Hand swagging machine to set teeth of saw used on sawmill (item 1-3) on gang ripsaw (item 5), on circular saw (item 11).	125.00
Circular saw grinding equipment, including wheel, fine adjustments to various sizes of circular saws, as above, with set of abrasive wheels. (HP required about 2. Space required about 3' by 2').	850.00
Small tool grinding machine, built specially to grind the tongue and groove cutting tools used on the planer and matcher (item 10) and/or the tennoner (item 13). (HP required about 2. Space required about 3' by 3').	250.00
Set of hand gages to measure accuracy of T.& G. knives	25.00
Set of standard small tools used for ordinary repairs and care and maintenance.	100.00
Combination boiler and engine, to produce steam for dry kiln and enough power to drive small sawmill. (HP requirements approximately 30.) Steam, generated by woodwaste, slabwood, etc. It is believed this item as well as the building materials, the electric motors required, and their wiring and starting units can be procured more economically on the local market.	
TOTAL	17,700.00

SHOP OPERATING PERSONNEL REQUIREMENTS

1	Sawmill Operator	$4,000	(Annually)
1	Inspector of Wood Products	3,000	
1	Tool Room Grinder and Operator	4,000	
1	General Foreman	3,500	
1	Gluer	2,500	
8	Laborers	16,000	

BIBLIOGRAPHY:

"Cross Circulation of Dry Kilns with Fans," Bulletin No. 5305-K, and Print No. 7396, by Moore Dry Kiln Company, Jacksonville, Florida.

Describes and illustrates the direct fired and steam-heated kilns sufficient to take care of 5,000 ft., board measure. Information present floor plans and details of dry kiln building, temperature controls provided for forced air circulation with the aid of proper fan system.

"Developments in New Flooring Blocks," by. U.S. Forestry Products Laboratory, Madison, Wisconsin.

Brief description and illustration of the preparation of hardwood flooring which can be laid directly on concrete surfaces, presenting a new method of making parquetry blocks of wood material.

"American Hardwood Flooring and its Uses," Trade Promotion Series No. 186, U.S. Department of Commerce, Washington 25, D. C.

Bulletin describes and illustrates types of American hardwood floors, their grades and sizes made in steps and square blocks, method of handling hardwood flooring and finishes used.

"Small Sawmill Operator's Manual," Agriculture Handbook No. 27, U.S. Department of Agriculture, Forest Service, Washington 25, D. C.

Most useful booklet of more than 100 pages on every phase of log cutting and sawmill operation from start to finish.

"How to Sell Hardwood Flooring," by the E. L. Bruce Company, Memphis, Tennessee.

A series of articles on the importance of knowing the characteristics of hardwood, their maintenance as floors, and the various manufacturing processes involved, including new types of square blocks marketed as blendwood block flooring.

"References and Bibliography on Laying, Finishing, and Care of Wood Floors No. 9135," U.S. Department of Commerce, Washington 25, D. C. Nov. 1935.

Presenting methods of finishing floors, depending upon kind of wood and finishes desired; and presenting various varnish, shellac, and seal finishes.

"Seasoning and Kiln Drying of Wood," The New York State College of Forestry, Syracuse, New York.

Most authentic book presenting solutions to such problems as proper piling of wood, periods of drying and seasoning, measuring the condition of wood with the proper instruments, showing and illustrating conditions under which successful drying is accomplished, and presenting drying schedules for various temperatures and humidity. Descriptions and illustrations are given of the various types of kilns, including information on how hardwood lumber should be used which is made into parquetry floors and what type of

dry kiln construction is most suitable under certain conditions.

"PB 106454, Furniture, April, 1952, 92 p." This report may be purchased from the Office of Technical Services, Department of Commerce, Washington 25 D.C. Price # 1.15, make check payable to the Treasurer of the United States.

In machining, finishing, and gluing of furniture or parquetry there are certain fundamental principles involved, and this report, prepared by a British team after its visit to the United States, presents a discussion with numerous illustrations of handling of wood material, production techniques involved in sawing and finishing lumber, temperature considerations, and how to maintain certain safety precautions in a parquetry shop.

Glues and Gluing: Discussion of these important subjects is presented in the following books and booklets:

"Modern Wood Adhesives" by T. D. Perry. Pitman Publishing Corporation, 2 West 45th Street, New York 36, New York. $4.00

"Resinous Products", by Rohm and Haas Company, 222 Washington Square, Philadelphia 5, Pennsylvania and Perkins Glue Company, Lansdale, Pennsylvania.

"Casein Glues", by National Casein Company, 601 W. 80th Street, Chicago 20, Illinois.

"Wood Adhesives", by Globe Machinery Manufacturing Company, 11th and East D Streets, Tacoma, Washington.

"Synthetic Adhesives", by Adhesive Products Corporation, 1660 Boone Avenue, New York, New York.

Names and Addresses of Paint, Varnish, and Wax Manufacturers:

These may be obtained from MacRae's Blue Book and Hendrick's Commercial Register, Consolidated, published by MacRae's Blue Book Company, 18 West 34th Street, New York, New York and Sweet's Architectural Catalogs, Volume "C", by Sweet's Catalogue Services, Division of F.W. Dodge Corporation, 119 West 40th Street, New York, New York. (Revised yearly).

Manufacturers of Machinery Used in Parquet Shops:

Corley Manufacturing Company, Chattanooga, Tennessee. Their catalogs describe a line of circular saws in detail.

Moore Dry Kilns, by Moore Dry Kiln Company, Jacksonville, Florida. Catalog shows setup of a large number of dry kilns, including one which would be sufficient to take care of 5,000 feet, board measure, with necessary instruments to control moisture, heat, and proper temperatures.

Yates American Machine Company, Beloit, Wisconsin. Catalogs complete line of woodworking machinery.

S.A. Woods Machine Company, 300 Dorchester Avenue, Boston, Massachusetts. Woodworking machinery in general.

The Jenkins Division of Curt G. Joa, Inc., Sheboygan Falls, Wisconsin. Multi-purpose woodworking machinery.

Hanchett Manufacturing Company. Big Rapids, Michigan. Grinding machines for saws and other woodworking machine knives and tools.

Newman Machine Company, Greensboro, North Carolina. Planer and matcher equipment, and circular saws.

Mattison Machine Works, Rockford, Illinois. Belt Sanders.

Bryan Machinery, Inc., 503 South Second Street, Memphis, Tennessee. Dealers in rebuilt woodworking machiner.

The name of any firm, product or process listed herein is not to be construed as a recommendation but merely as a typical reference. Commercial directories will generally supply additional sources of information.

NOTE: To obtain copies of any catalogs, bulletins and other reference material mentioned in this report, please write directly to the indicated source of issue or supply.

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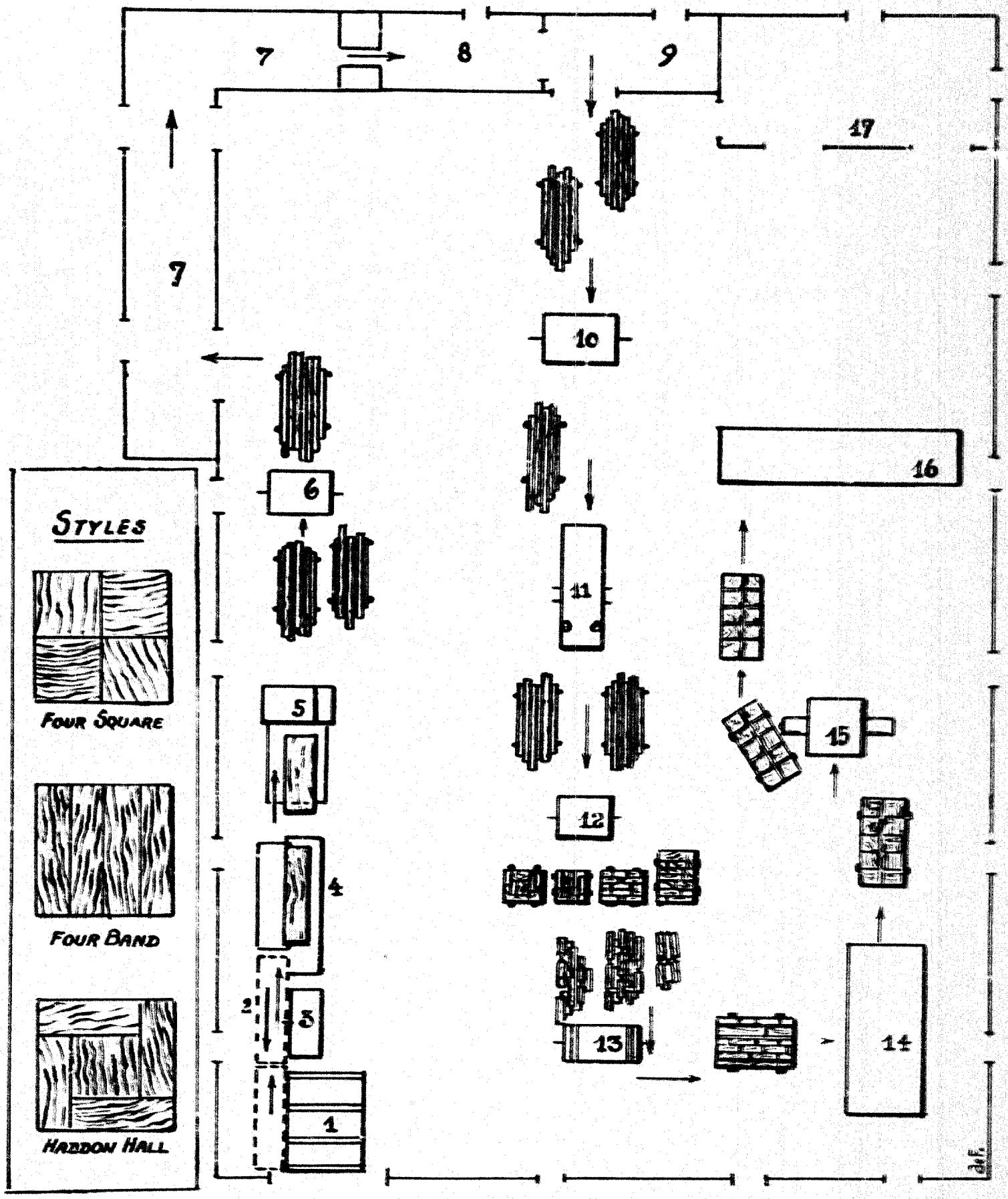

The Shop

TO MANUFACTURE PARQUETRY