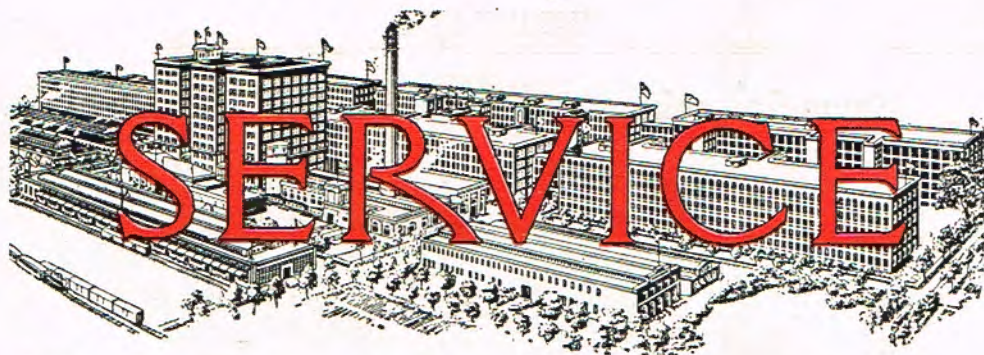


F. W. Reynolds



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Making enameled cabinets

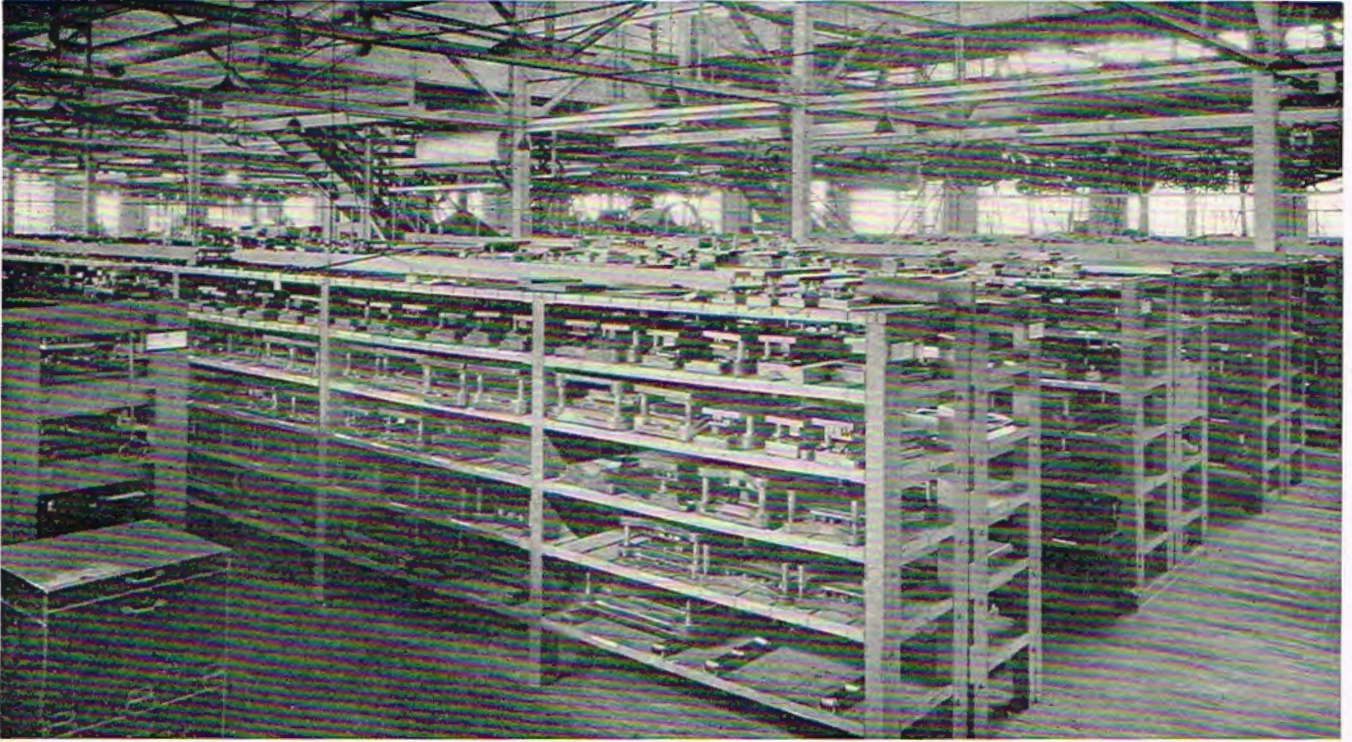
Seven years ago the enameled steel cabinet was made standard equipment on high-grade National Cash Registers. The adoption of this improvement required an enormous investment for equipment. In addition to the cost of the new tools and machinery necessary for building the new cabinets, it meant the scrapping of the thousands of dollars' worth of the equipment which was used for making the ornamental cabinets.

The excellent service given by the new finish and the improved appearance of the registers amply justify the foresight of those responsible for its adoption. Enameled cabinets sent out on registers seven years ago have not only maintained their original luster but show a much greater resistance to the effects of usage than the old type of finish.

Our enameled cabinets have fully proven themselves as high-grade additions to the highest type of cash register mechanisms. Inquiries are often received with regard to the ability of our workmen to accurately copy the natural grains of the woods, and at the same time provide a finish which so successfully resists all the elements of use and time.

The painstaking care with which the various steps in the making of these cabinets from the raw materials to the finished product are handled is briefly explained and illustrated in this bulletin.

Enameled cabinets for National Cash Registers



A small section of the tool supply room containing the thousands of special dies, gauges, and other tools designed for the manufacture of enameled cabinets of National Cash Registers

Three quarters of a million dollars invested in tools and machinery for making enameled cabinets

The tool and machinery equipment necessary to produce enameled cabinets up to the point where they are ready for the Enameling Department represents an investment of \$750,000. \$250,000 worth of tools, patterns, and machinery used for manufacturing the ornamental cabinets was abandoned, making the total cost of the change more than a million dollars.

Included in the tools necessary to produce the cabinet parts are more than 100 large dies costing more than \$1,000 each. These are so large in size that it is necessary to use a special elec-

tric lift truck to handle them. Twenty-one of the latest improved and largest type punch presses are used to blank form and pierce the steel into a cabinet part. These are part of the machine equipment installed at a cost of more than \$100,000 for the production of the enameled steel cabinets. The illustrations show a small part of the equipment used.

This equipment requires 25,000 square feet of floor space and 68 employees. During 1922, 2,601,695 pounds of furniture steel was used for making these cabinets.

Enameling the metal cabinets

The enameled cabinet was brought out to satisfy the demand from our users for a finish which would match store fixtures and improve the appearance of the register. In addition to meeting these requirements, the enamel finish has a longer life and can be kept in good condition longer than either of the nickel, gold, or other plated surfaces.

Years of research required

As the result of the exhaustive investigations and laboratory tests by our factory experts, the enamel process first used on registers shipped early in 1916 was far superior to any which had previously been produced. Even this excellent quality has, however, been improved many times since it was first put in use, so that our

users are still receiving a finish far advanced of any other that is being produced today.

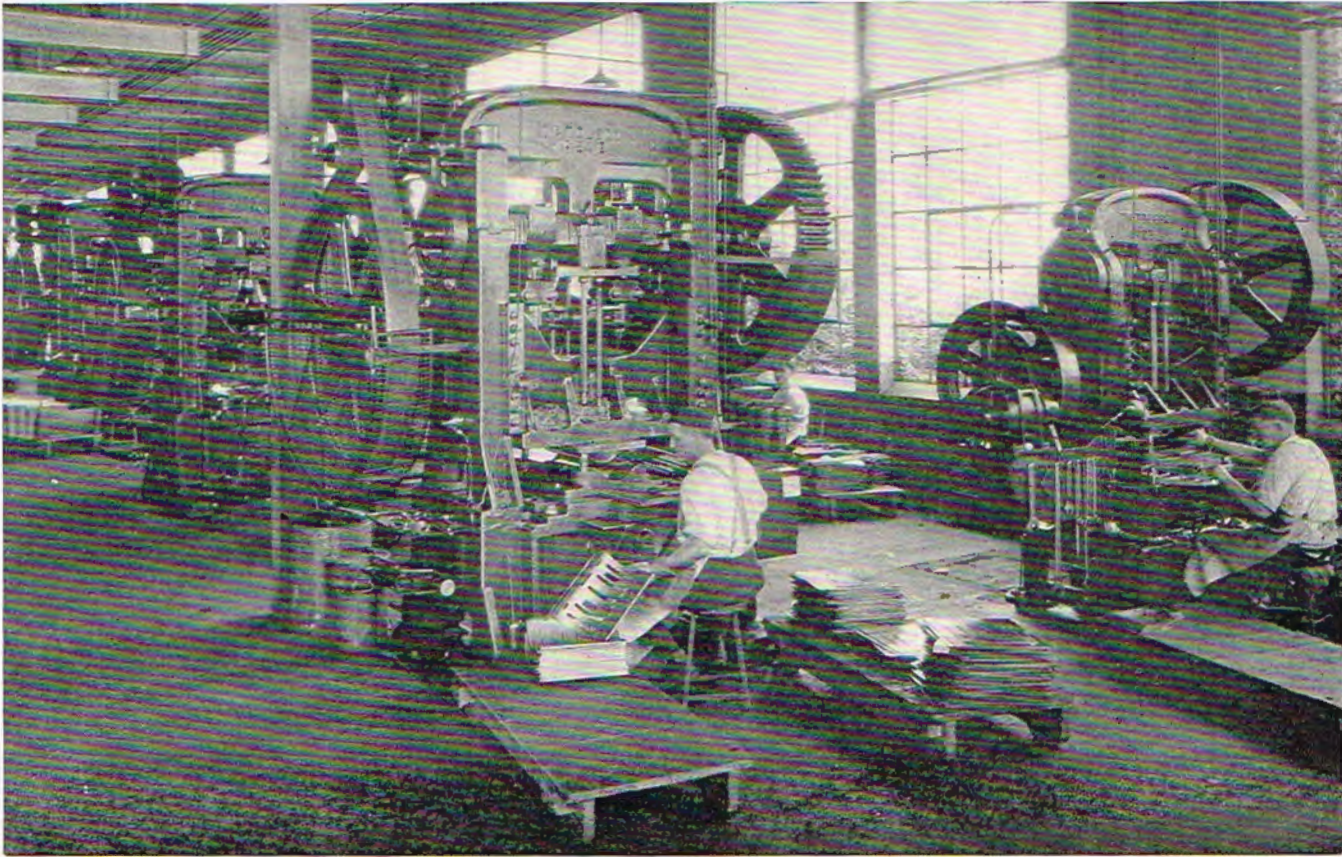
Highest grade processes, materials, equipment, and men used

This is only made possible by the special processes, the use of only the highest grades of material, the most advanced equipment, and the employment of thoroughly trained chemists finishing experts. Without these requisites it is impossible to produce a finish that will meet our requirements.

Equipment specially designed

It was also necessary to design special equipment: first, to reproduce the grain of the woods;

Thirty separate operations required to complete enameled cabinets



A small section of the twelve enormous presses required to cut out and form cabinet parts

second, to transfer this reproduction to the metal; third, to bake the material so that the correct degree of hardness, flexibility, and color was obtained. This requires special ovens and hundreds of experiments to determine the correct degrees, temperatures for the various finishes, and the periods of time during which the parts remain in the ovens.

Fifteen separate finishing operations required

There are a number of other conditions which must also be taken into consideration if a finish of superior quality is to be obtained. Our standard finishes require fifteen separate and distinct operations or steps after the metal has been prepared for the finish. Ten of these have to do with the enameling and finishing, the other five are baking operations. The services of 184 expert finishers and grainers are required to produce our output.

Grinding and cleaning cabinet surfaces

A majority of the cabinet parts are made from steel. To obtain a smooth finish it is first necessary to grind the metal down so that the surface will be perfectly level and as smooth as possible. After this operation is completed each part is washed thoroughly in a liquid cleaner which removes all grease and oily substances which have accumulated on the metal during preceding operations. It is only after the cabinets have been prepared in this way

that they are sent to the Enameling Department for finishing.

Compressed air removes dust and foreign particles

When a cabinet is received in the Enameling Department it is placed in a large compartment and subjected to drafts of air under high pressure to remove every particle of dust or foreign substances. This assures that the surface of the parts will be thoroughly clean before they receive the first operation or the ground color, which is the beginning of the enameling process.

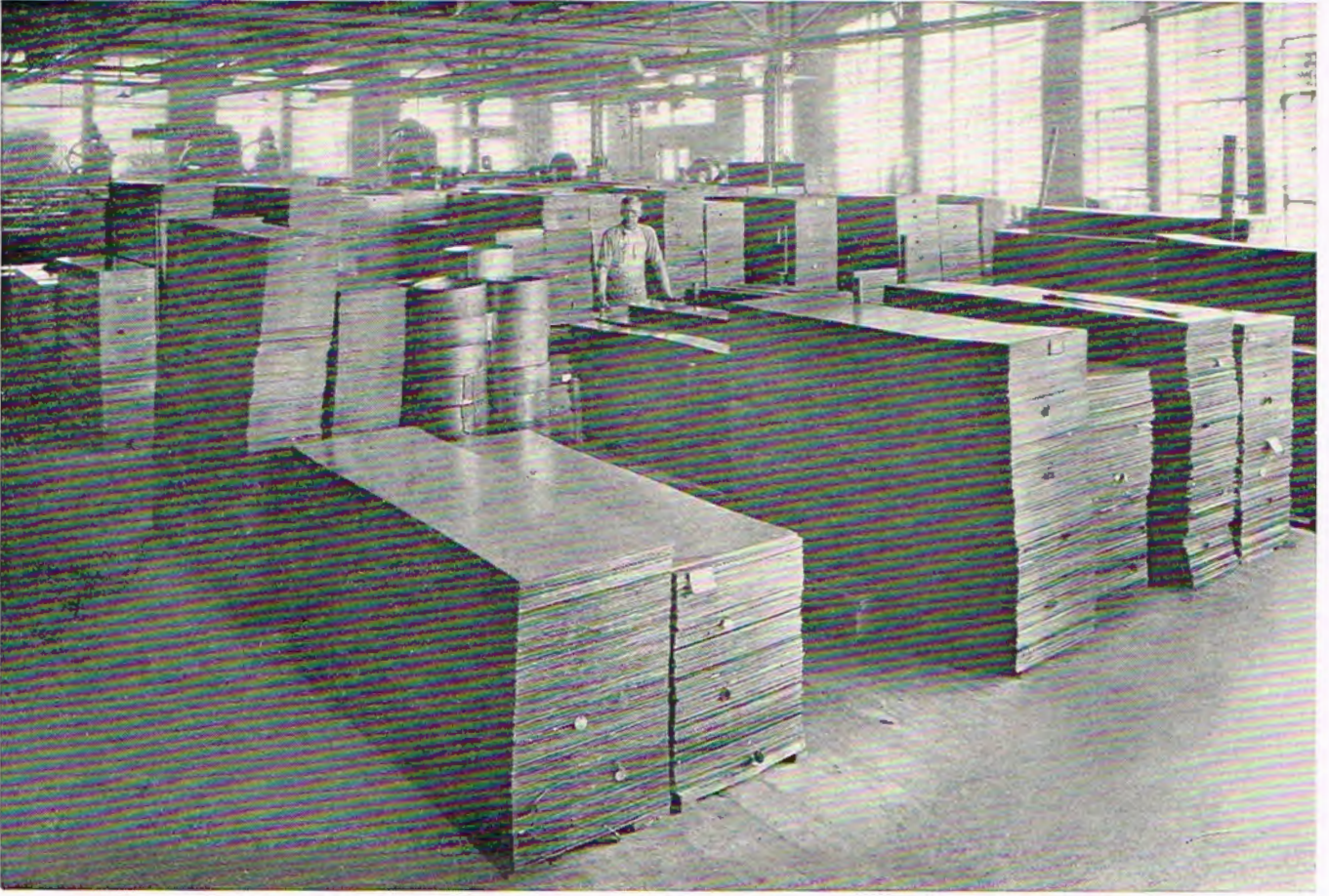
Use of air brush insures proper application

To insure that the parts are thoroughly covered with the proper amount of material, the color is applied with an air brush. The entire surface of all cabinet parts receives the ground or first coat. The inside of the parts is coated to protect them against any possibility of rust from moisture.

After the ground color has been applied the parts are placed in an oven and the finish thoroughly baked. Temperatures of from 200 to 400° Fahrenheit and periods of from one to six hours' time in the oven are required to obtain the necessary firmness and prepare the parts for the next operation.

Inspection for finishing errors

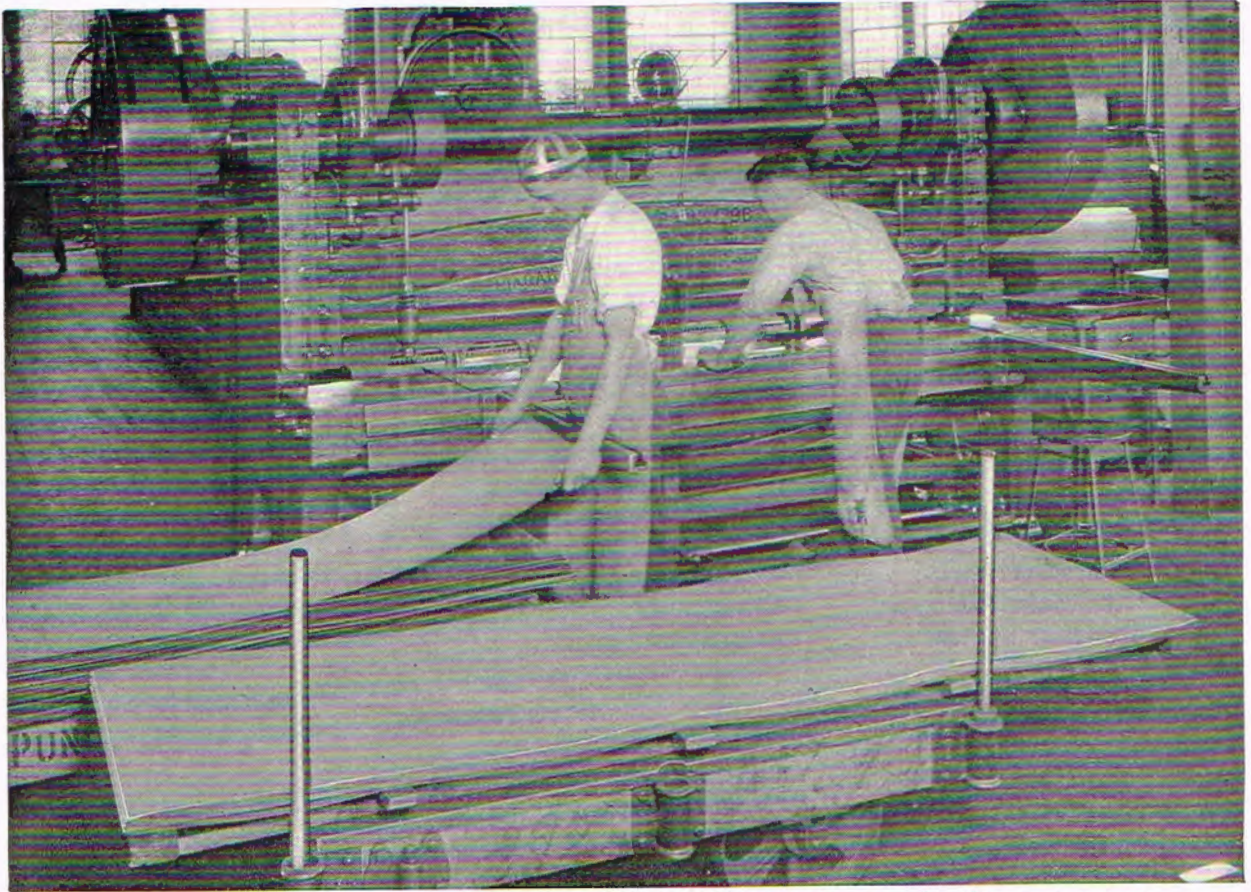
The cabinets are now ready for the putty operation. At the same time all of the cor-



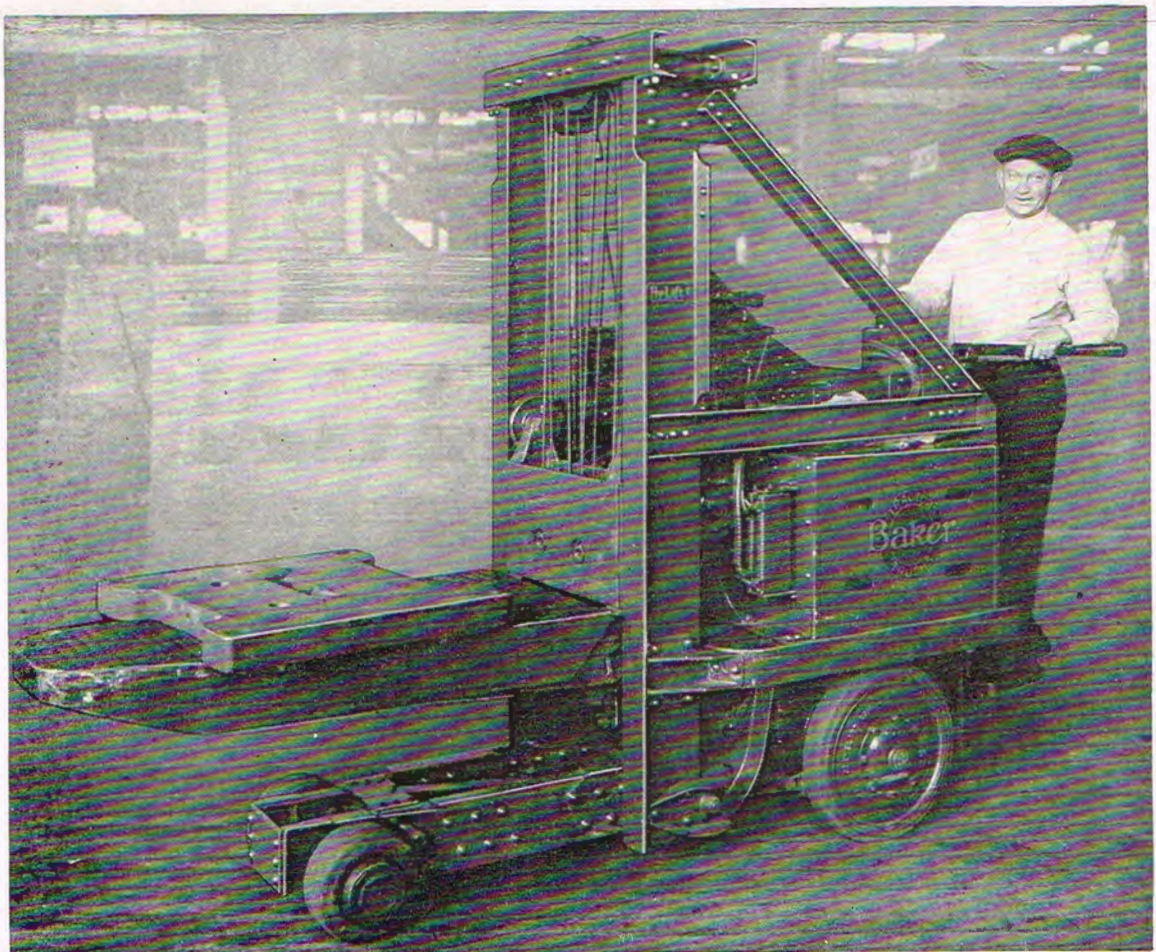
Small section of stock room containing special steel for making enameled cabinets



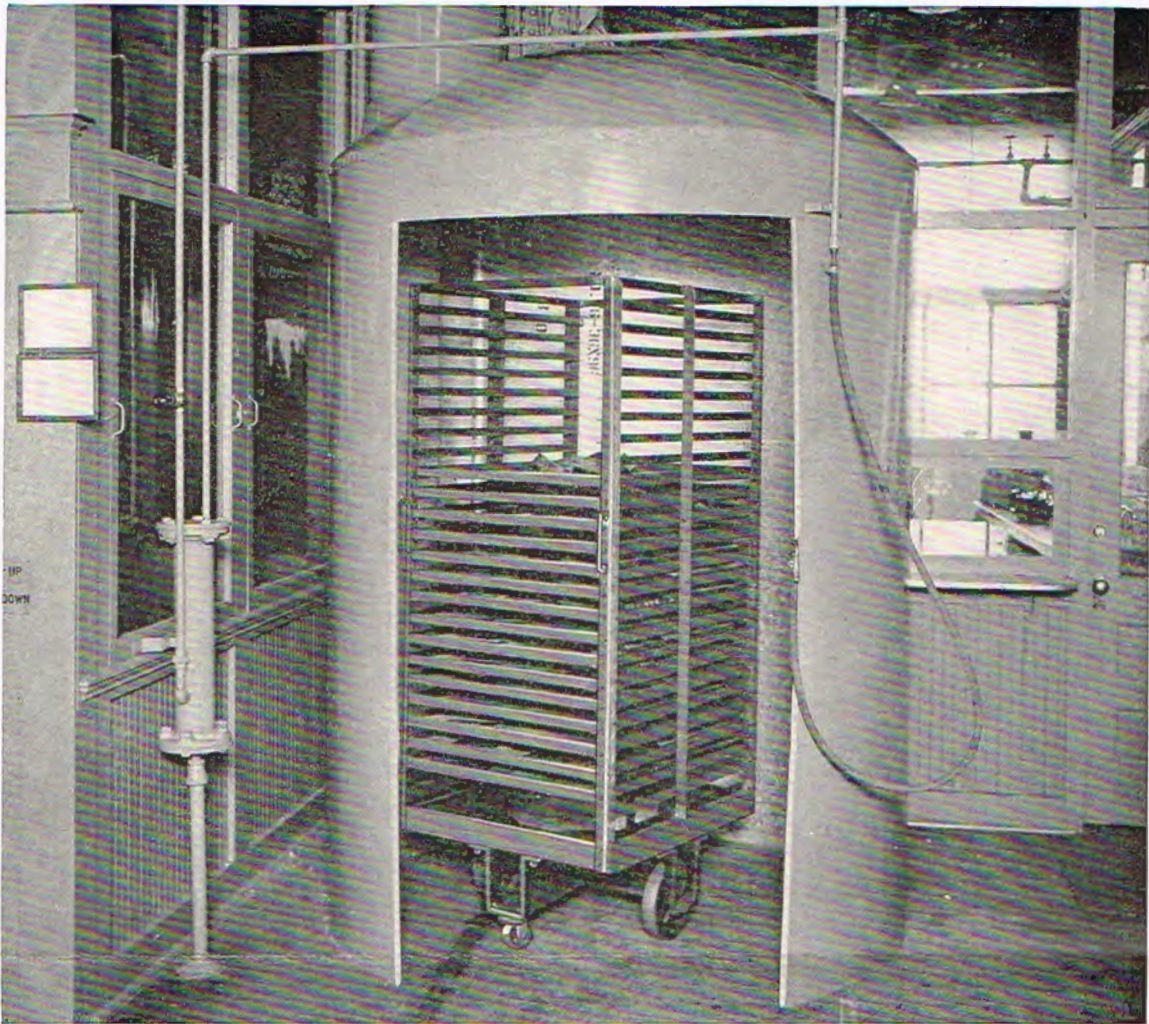
Thirty steel racks contain 210 special butt plates weighing 1,000 pounds each. These are a part of the tool equipment



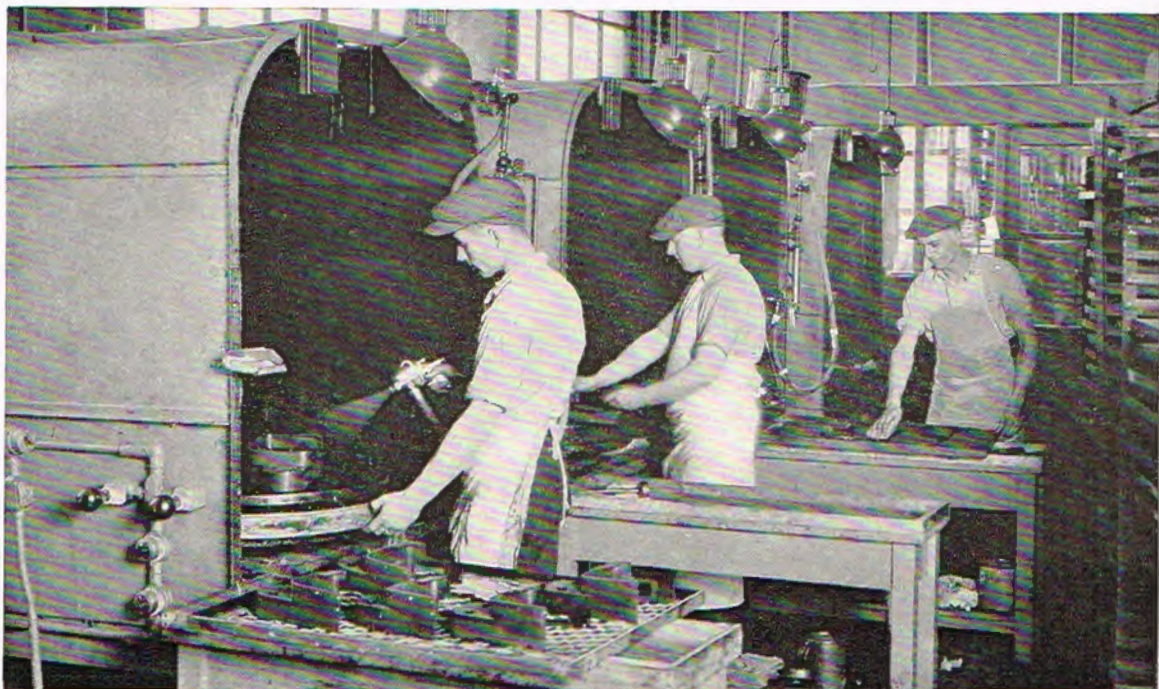
One of the mammoth shearing machines used to cut cabinet steel of size for the punch presses



The special electric hoisting machine required to handle the special tools between the tool supply room and the presses



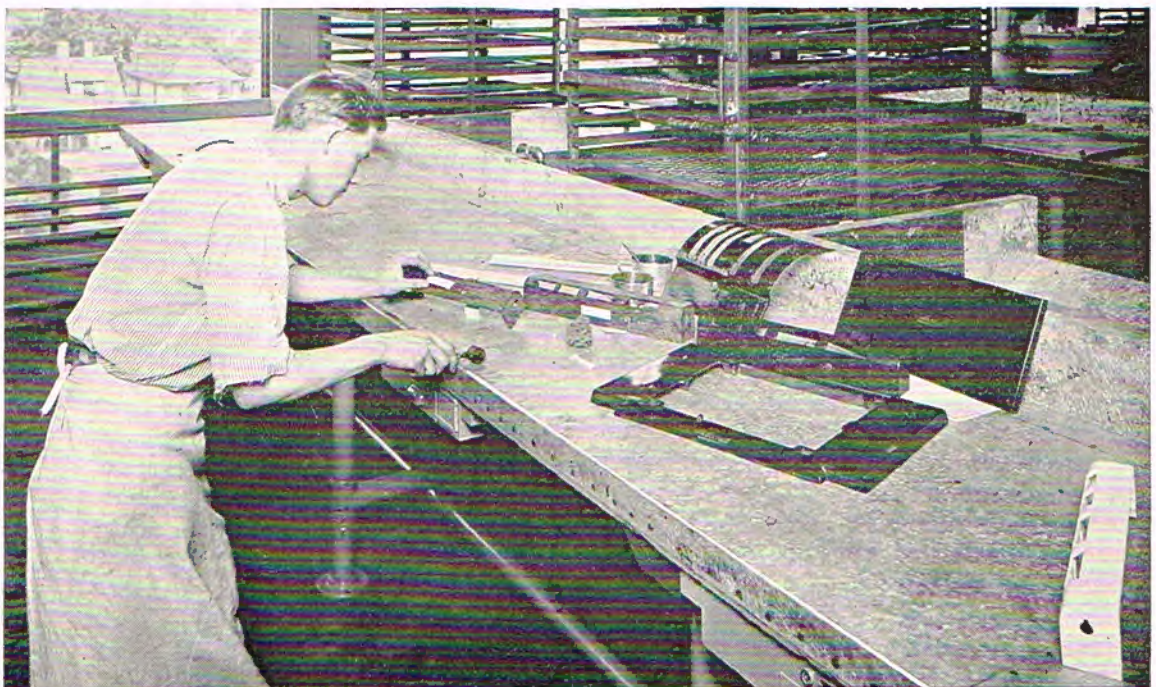
Compressed air cleaning chamber, showing cabinets in steel rack ready for cleaning



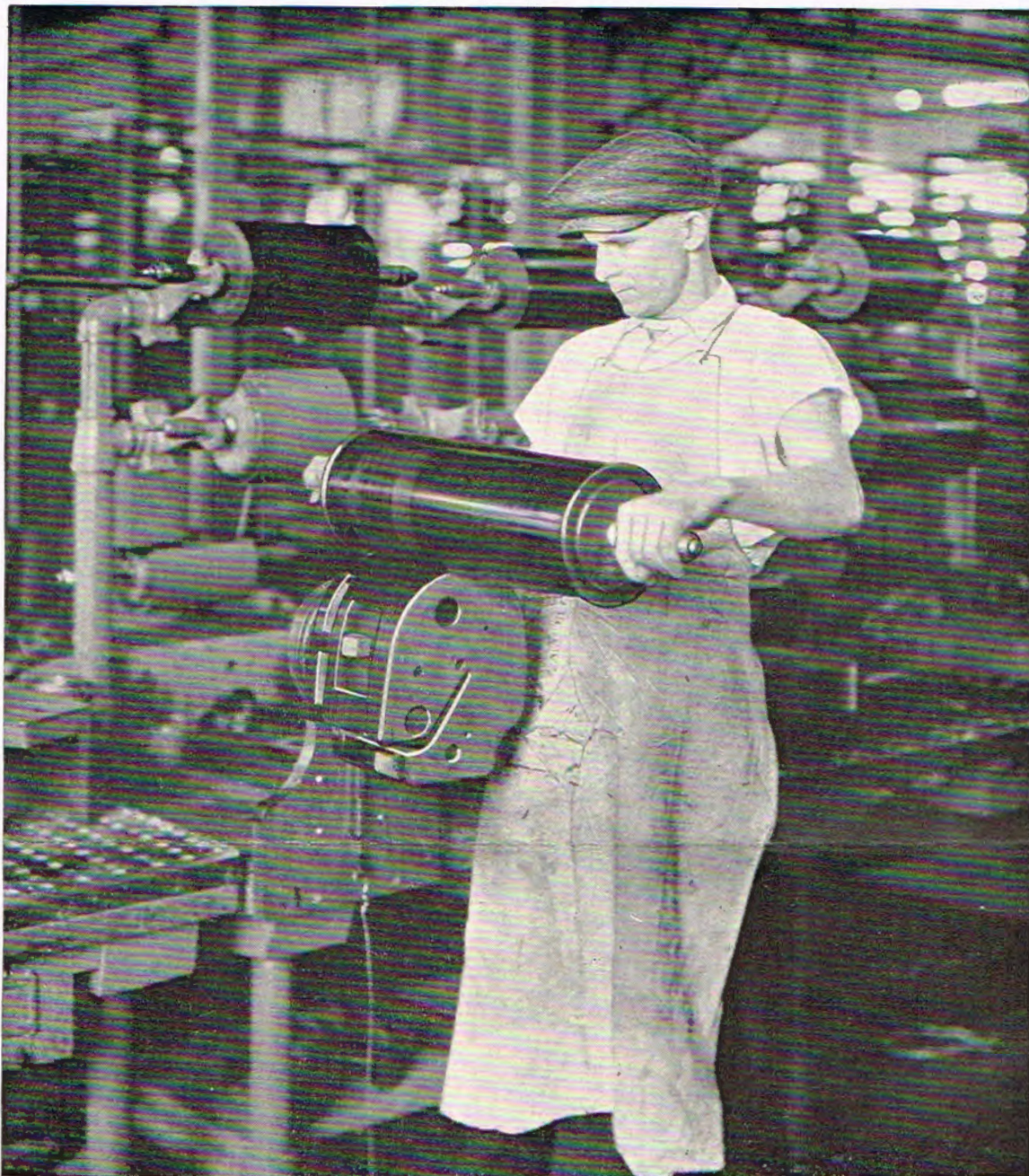
Applying the ground coats with air brushes



A section of the graining room



Putting the trade-mark "National" on the cabinets



Transferring the mahogany grain from the rubber roll to a Class 900 printer hood

ners are covered with the color and all spots or defects of any kind are remedied. It is only after these details have been taken care of satisfactorily that the cabinets are ready for the next coat of ground color. When this is completed the cabinets are again baked to dry and harden the finish.

Preparing enamel for graining

The first sanding operation is then given the cabinet to smooth the finish and remove any conditions which are not entirely satisfactory. This also prepares the cabinet for the graining color operation.

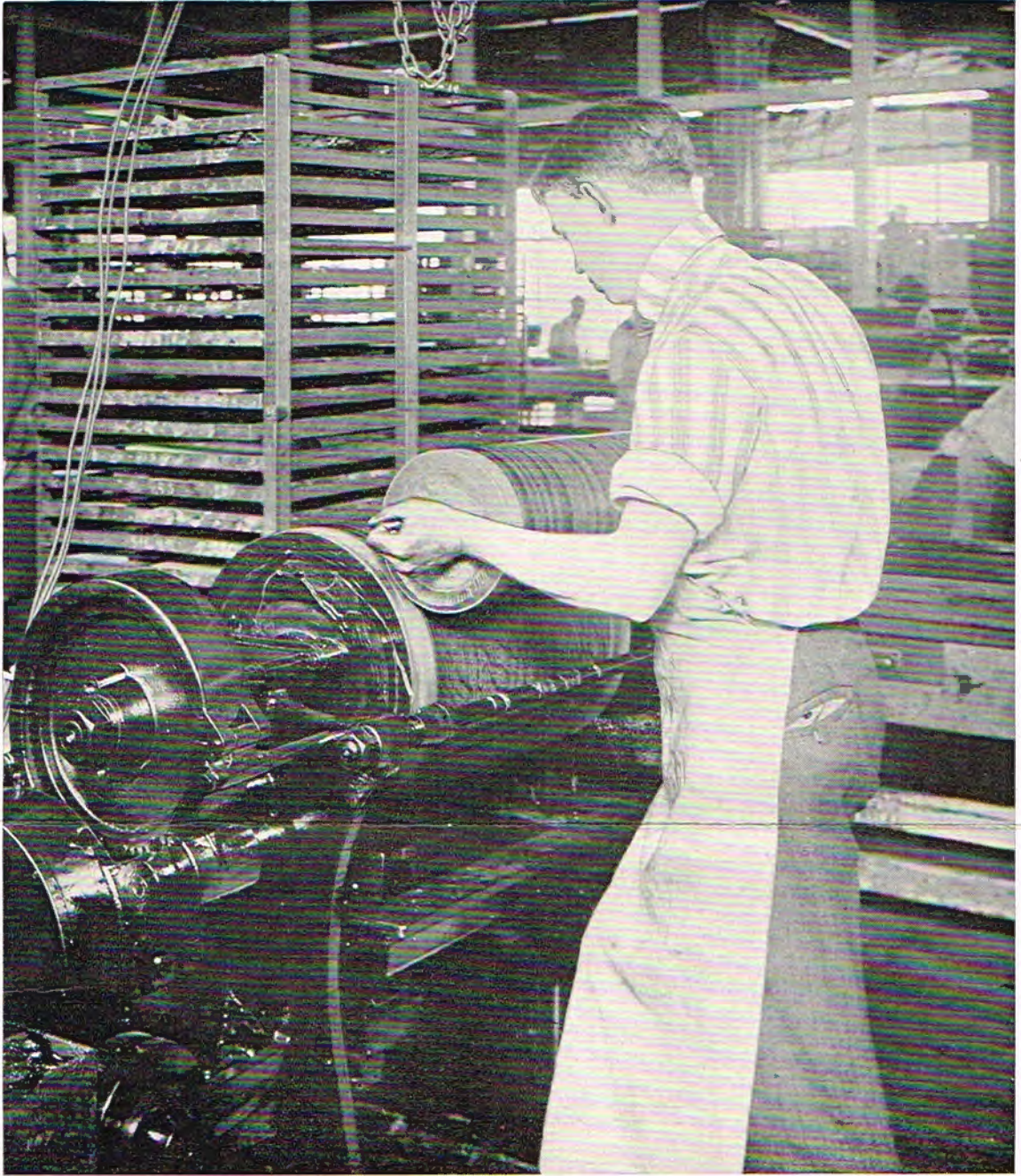
By this process the exact reproduction of the grain in either oak or mahogany woods is produced on the cabinet parts. Even with our extensive equipment, considerable skill is required to properly print the grain on the parts

of the cabinet so that they will match with each other when all are assembled into the complete cabinet and present the appearance of a natural wood grain.

When the graining operation is completed the cabinets are again placed in an oven and baked until the finish has been properly hardened for sanding. At this time it is only necessary to sand down any rough places which may have accumulated during the graining and baking.

Special varnish applied with air brush

When the sanding has been completed the part are thoroughly cleaned of dust and given a coat of special varnish. The use of an air spray carries the material to every part of the surface and insures a finish more smooth than could be produced by hand. It is again necessary to bake the cabinet to harden the varnish.



Transferring the wood grain from special plate to the rubber printing roll

Considerable research work was required to determine the correct length of time and temperatures to use in baking, so that the proper shade of colors for the different finishes would be obtained. A variation in the oven temperatures or the time makes a difference in the color of the finished product. It is necessary to give these points particular attention, and the use of automatic devices on our ovens prevents as far as possible the element of human error which would otherwise be present.

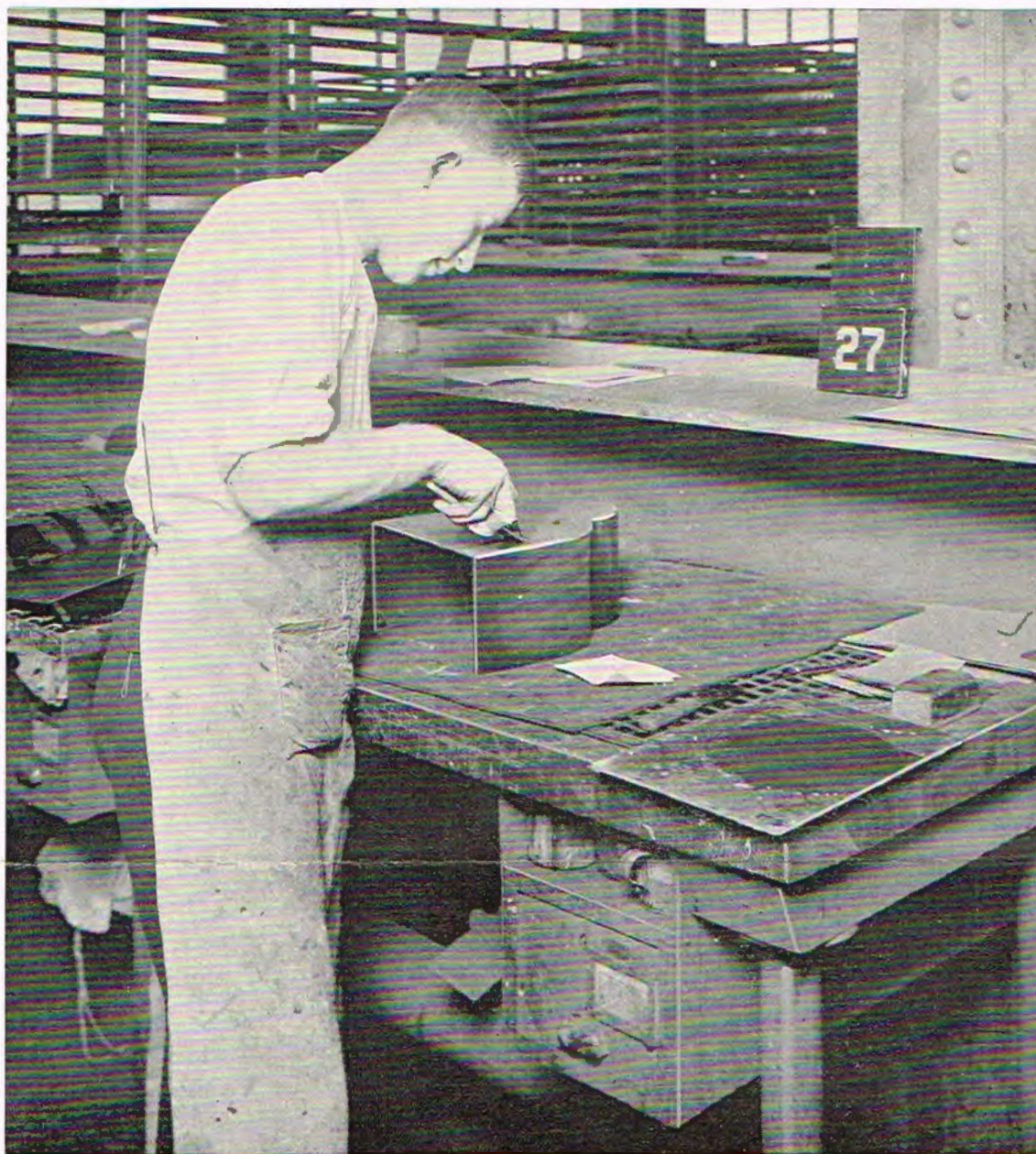
Each finishing coat must be carefully baked at proper temperature

When the varnish has been sufficiently baked it is ready for the third sanding. The first coat of varnish is sanded to a smooth surface and any crevices or holes are filled. This requires expert workmen to prevent the graining being

destroyed during the operation. This work is very important, as any oversight at this point would seriously affect the finishing operations.

Finish must pass rigid N. C. R. inspection

Another coat of varnish is then applied and baked, after which the cabinets are ready for the rubbing operation. The velvet finish is produced through the use of pumice stone and oil. It is the completed work of expert craftsmen. When this operation has been completed the cabinets are ready for delivery to the Inspection Department. Here a thorough examination of each part is made for quality of finish, degree of hardness, reproduction of grain, spots, and color. After the cabinets successfully pass this inspection they are ready to be assembled and placed on National Cash Registers.



Examining parts for finishing errors and correcting them

Special finishes

Through the use of specially developed processes and the experience of experts, any special finish, or color desired may be reproduced. Samples of woods are submitted from users in all parts of the world and accurately reproduced on the cabinets. The considerable amount of special work required on finishes of this kind makes it necessary to charge additional to cover the expense incurred in building the special finish.

Expert finishers must have special training

The work must all be done by specially trained experts who must first experiment to determine what combinations are required to obtain the exact color in the finished product.

To obtain this information it is necessary to make a sample and keep records of what combinations were used on each operation.

Samples must go through fifteen operations

The sample must go through all of the fifteen operations required for the regular cabinets. This is necessary because different temperatures and baking periods are required for the various combinations of colors. After the proper finishes have been obtained on the samples, the workman is ready to begin his work on the cabinet.

In many cases the grain is hand drawn and copied from the samples. It is needless to say that this requires a great deal of experience and an expert knowledge of wood grain reproduction. The completed cabinet must pass the same rigid inspections as are given our standard finishes. In most cases the extra charge made for the special finish barely covers the factory cost of the work.



Using the special N. C. R. rubbing machine

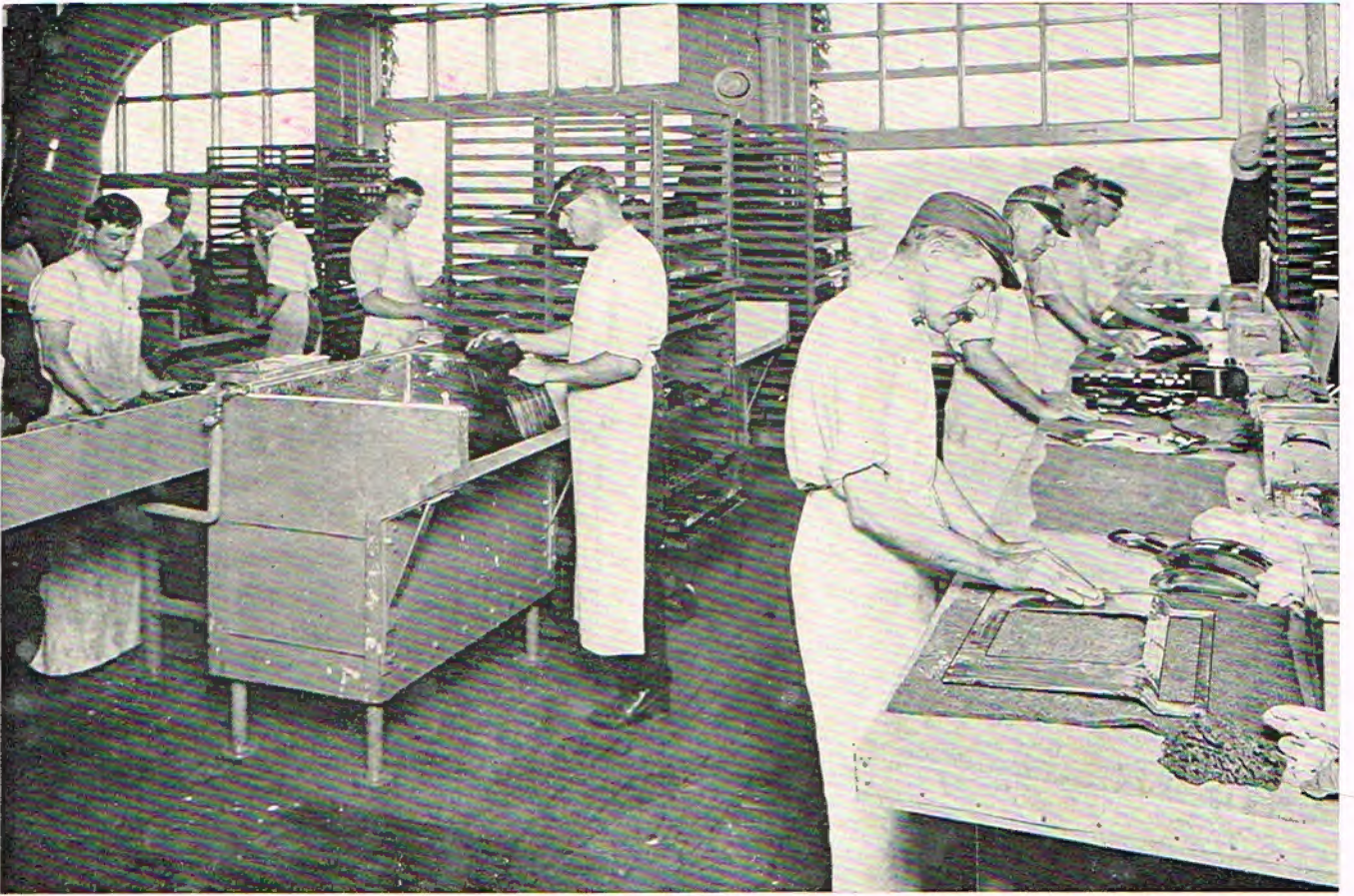
Majority of equipment of special design

To provide a finish in keeping with N. C. R. standards, considerable research work was first required. The special graining plates were developed to obtain the exact reproduction of the wood grain on the cabinets. Hundreds of tests were made of materials and devices.

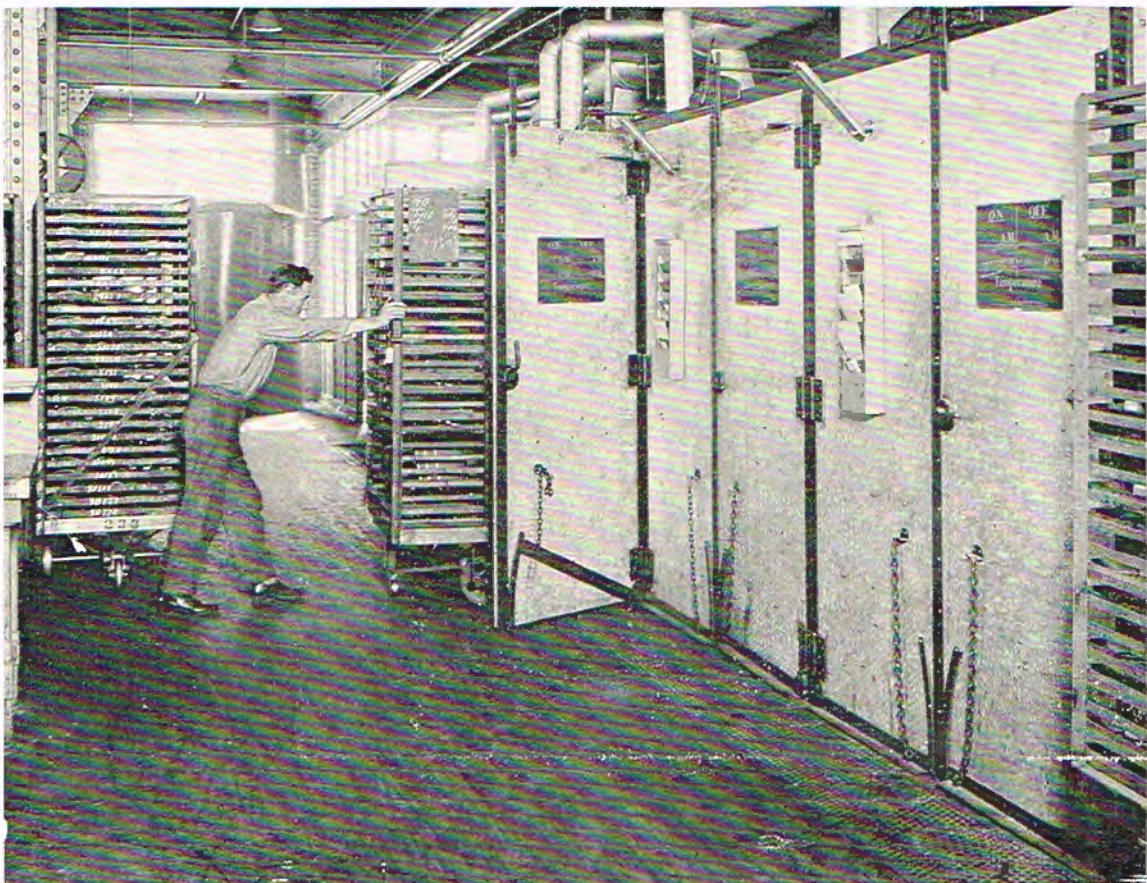
Ingenious machinery is used and many devices have been designed in our factory for the purpose of improving the finish of our enameled cabinets. These include the automatic heat control devices for ovens, inking machines for the graining plates, the cleaning mechanism for the inking rolls, electrical, gas, and steam heating apparatus for the ovens, compressed air cleaning system, spraying rooms, inking rolls, rubbing machines. In addition to these, many special formulas have been developed for producing correct colors. New and improved methods are being developed continually to further improve the finish of our enameled cabinets.



Preparing test plates to determine color combinations for special finishes



Rubbing and sanding cabinet parts by hand



A section of the baking ovens for enameled cabinets