

the most convenient for making rough boxes and these are the numbers most frequently used; No. 60 for about two-thirds of the boxes and No. 50 for the other third.

Stay paper is used for binding the intersections of the sides and ends of the boxes and covers. There are two different grades. Straw colored boxes are finished with a $\frac{3}{4}$ " wide Kraft paper of a basic weight of 132 lbs. per ream of 500 sheets sized 25"x40". Slate colored boxes require a $\frac{3}{4}$ " grey manila paper having a basic weight of 127 lbs.

Both of these papers are gummed before use with an animal glue, about 24 lbs. of glue being spread per basic ream of paper.

The paper applied to the intersection of the bottom or top with the sides or ends is known as stripping paper. For this purpose, with strawboard a $\frac{7}{8}$ " wide 42 lb. Kraft paper is employed, but with newsboards a grey manila paper of the same width and weight.

Both of these papers are gummed during the process of stripping with a cold liquid vegetable glue which is kept at a temperature of about 110° F, so that it will flow easily and dry quickly.

The gum used for sticking the ends on the boxes depends on the kind of board and the type of machine used. There are several gums for this purpose on the market and some of them are good.

Manufacture of the Box

The newsboard is received from the mill in various sizes and thicknesses and is stored in the basement for a month or so for seasoning. For boxes in great demand special sizes and thicknesses of board are ordered; the size is such as to result in as little waste as possible; the thickness depends on the size of the box and its future contents.

When the board is needed for an order it is trucked to the box department and placed near a double scorer. It is the function of the double scorer to cut the board into blanks of the exact size needed and at the same time to score the blanks along the lines of flexure. The machine accomplishes this by receiving each separate sheet of board between a set of rolling knives and a soft iron cylinder and then automatically feeding it to a second set of knives and cylinder set at right angles to the first. The machine, operated by a semi-skilled operator who sets the knives, feeds in the board, and breaks apart the blanks, cuts an average of 790 sheets of board an hour. It runs at a speed of about 140 R. P. M., and requires a 4" belt to turn its 16" diam. pulley.

The double scoring machine operator breaks apart

the blanks coming from his machine and places them on a castored table (Figure 3). The castored table is designed to move goods from one machine to another in the same department and is a great labor saver. The table receives the material completed by one machine and holds it until it is needed by the next succeeding machine. The table with the material is then wheeled over and the second machine fed directly from it. This is precisely what occurs to the material passing between the double scorer and the miterer or corner cutter.

Mitering is the operation of cutting the V-shaped notches in the blank and is performed on all box blanks which have their ends cut separately, so that the flanges will not overlap at the corners. Cornering is the operation of cutting the square corners from the blanks and is performed on cover blanks with which the ends are cut contiguously. It accomplishes the same purpose as mitering.

If the blanks are to be cornered, the castored table is pushed over to the double-corner cutting machine. The operator picks up several thicknesses of the blanks and places the ends in the machine. Two reciprocating 90° knives come down on the blanks and shear off the two end corners. The blanks are turned about and the other two corners cut off. When properly cornered, the blanks are placed on another castored table for the bender. The double-corner cutter receives its power through a 3" belt and a 20" pulley and runs at a speed of 140 R. P. M. A modification of the double-corner cutter is the miterer-corner cutter. One side of the machine is a duplicate of the double-corner cutter and performs the same operation. The other side is fitted with two V-shaped knives which cut the board in the same manner as the double-corner cutter. Both machines will cut an average of about 2250 blanks an hour when running at a speed of 140 R. P. M. The miterer-corner cutter requires a 4 $\frac{1}{4}$ " belt to turn its 20" pulley.

From the corner cutter or miterer, all corner-cut blanks and all mitered blanks which are to receive their ends on a single ender are pushed on another castored table to the nearest bending machine. The blanks are piled on the receiving end of the machine and an endless belt picks them one at a time in rapid succession from the bottom of the pile, passes them over and under adjustable guides, which bend the flanges up and back, and then shoots them at a rate of 3,500 an hour on to the receiving bank where they nest themselves in a neat pile. The machine is belt

driven by a 3" belt turning a 14" pulley at 140 R. P. M.

The blanks are now stored by the bending-machine operator in stock bins or in apportioned spaces on the floor until they are to be made into boxes.

The rectangular ends which are to be glued to the blanks are cut on the guillotine knife. The machine takes its name from a well-known apparatus of the same name and operates in a similar manner. Raw board, or sometimes the trimmings from the double scorers, is piled on the platform of the machine in layers up to four inches thick, and is set under the knife in the desired position by means of a movable back guide. A lever is manipulated and a large knife extending the width of the platform is forced down, cutting all thicknesses of the board at once. The strips of board cut by this first operation are then placed in the machine at right angles to the first position and cut off to a desired dimension. In this manner 4,250 ends may be cut in an hour. Power is applied by a 3" belt to the 16" pulley turning at a speed of 150 R. P. M.

When the blanks are to be made up they are taken from their storage location to either the single or the double ending machine. Small quantities are done on the single ender, but jobs of over 2,000 boxes warrant the use of the double ender. The double ender will do the work about two or three times as quickly as the single machine, but requires special blocks and a longer time for set up. These machines apply glue to the flanges of the blanks and then paste the ends in place.

The single enders apply the ends which have been cut by the guillotine knife to the bent blanks which come from the bending machine. The ends are fed into a hopper at the top of the machine, are glued automatically, and one at a time are placed in position to be pressed on the box blanks. The box blanks are taken by the operator from a table at his side and are held on an adjustable form. Upon pressure on a foot treadle the machine actuates a toggle joint which presses the form holding the box blanks against the glued end. The box is turned over by hand and the other end attached in a similar manner. An average operator can handle 300 boxes in an hour. The single ender is fitted with a 16" pulley driven by a 3" belt and runs at a speed of 180 R. P. M.

Large lots of much used boxes are made on the double-ending machine because it is entirely automatic. The box blanks are piled at the end of the machine and the ends in hoppers near the front of the machine. The box blanks are automatically fed under a form which comes down on the blank and forces it between two

guides, thus bending up the sides of the blank to their proper positions. The flanges are then glued and the ends pressed into proper place, both at the same time. The boxes drop on to an endless moving belt which delivers them to the rear of the machine. One man tending this machine can produce about 600 boxes an hour, but if greater production is desired a girl helper can be used to receive and stack the boxes as delivered from the belt. The two working on the machine will produce about half again as rapidly. The machine is driven by a 16" pulley running at about 175 R. P. M. A 3" belt is used.

All of the machines described above, together with an extra double scorer, bender, single ender and double ender, are driven through 2" line shafting by a 5 H. P. 950 R. P. M. electric motor.

After the boxes have been formed they must be stayed and stripped to secure strength and stiffness. Staying is the process of sticking a strip of $\frac{3}{4}$ " gummed paper along the sides and end intersections of the box. Stripping is the process of applying a similar $\frac{7}{8}$ " strip around the edges where the sides or ends meet the bottom. Covers are also stayed and stripped; stayed in order to hold the sides and ends together and stripped for strength and stiffness. The two machines which do this work, the staying machine and the stripping machine or covering machine, are run as a single production unit because each turns out approximately the same number of boxes or covers per hour.

The boxes are carried from the ending machines by a move man and are placed at the right hand of a staying machine. The girl operating the machine takes one box at a time and places it in the proper position on the machine which presses a gummed stay into place on a corner. This operation is rapidly repeated for the other three corners of the box. The stayed box is placed on a table at the left of the machine in a convenient position for the stripper. The box stayer is fitted with an 18"x4 $\frac{1}{2}$ " pulley and is driven at a speed of 130 R. P. M. by a 3" belt from 2" line shafting. The cover stayer uses a 12"x3 $\frac{3}{4}$ " pulley and is driven at 140 R. P. M. through a 2 $\frac{1}{2}$ " belt by an individual 1/5 H. P. motor.

Box covering machines are used for the operation of stripping. The girl operator takes the boxes from the table at her right hand, where they have been placed after staying, and places them on a wooden block on her machine; one wooden block is required for each different size of box made. The end of the paper strip which has already been glued by an attachment on the