

**Hat Making.** The manufacture of felt hats in the United States has, by the introduction of improved machinery and methods, reached a high degree of perfection and importance.

Fifty years ago the business was carried on in small establishments in towns and cities and in very small shops, even in villages. In the latter case the implements were almost as simple as those of the shoemaker, and a boss hatter, with one or two apprentices, made the hats for the surrounding district.

Wool and fur, with other hatters' supplies, were furnished by city merchants. The wool was simply carded, and the hatter, with his bow, shaped it into a hat body and then finished it.

The best machinery for making felt hats is of American origin and much of it has found its way into Europe, superintendents and workmen having come to this country to study the American method and become acquainted with the uses of the machines which have been exported to Europe.

This invasion of American machines reminds one of the complaints of the hatters of London, nearly 150 years since, in a memorial to the British Board of Trade, at the extent to which the manufacture of hats was carried on in New England and New York.

Beaver fur hats were formerly considered the best, but as that animal became scarce other furs were substituted for the body, which was covered with beaver fur on the outside. This mode of manufacture has now disappeared, and both soft and stiff felt hats are made of wool or of furs as two distinct branches of manufacture, which are carried on in different establishments and use almost entirely different machinery.

In the wool-hat factories are used all those machines which are ordinarily employed in cloth manufactories to prepare the wool for spinning; while the fur-hat factories have a set of special machines.

The hatter of 50 years ago laid the fur or wool, which had been previously prepared, on a hurdle made of wood or wire, with openings to let the dirt fall through. He then, by means of his bow, scattered the fur in all directions. The bow was usually made of ash, 6' or 7' long, with a catgut string stretched between the two ends. With a stick this string was caused to vibrate, and the fur driven from one end of the hurdle to the other. The layer of fur was called a *bat*, was made in a triangular shape, and formed one half of a hat body. It had to be carefully joined to another piece of the same shape, the edges overlapping each other, and the two portions, so united, with a cloth of the right shape between them, were patted on a hot-plate, while water was sprinkled upon them until the fur became partially felted and the cone-shaped hat-body had become tolerably firm.

The hat-body was now taken to the *battery* to be felted. This process consisted of rolling the body between cloths, continually changing its position in the cloth, while it was kept as hot as possible by dipping it into acidulated water kept boiling in the *sizing-kettle* by a small fire underneath. Special care was taken to shrink the hat body alike all over, and to reduce it from the size of a conical bag almost three times the dimensions of the finished hat-body. When the body was made of wool, and was to be *napped*, a cone of fur, bowed as described, was laid over it and wetted down with a brush until the fur adhered to the body firmly enough to continue the rolling between the sizing cloths, the body being kept hot by dipping it into the sizing liquor, as before, and this was continued until the loose fur had penetrated and formed a part of the body.

To give the hat-body its shape was the next operation, and this was also done on the *battery*. Having been thoroughly soaked in hot water, the operator laid the hat body on the plank which forms the margin of the *battery*, with that part of the body which was to form the brim turned up, and while turning it around on the plank pulled out the tip to form the flat portion of the hat crown. The body was

now pulled on to a block of the size and shape of the finished hat crown, a cord slipped over the crown, and drawn tight at the junction of the side crown and the brim. In this condition the brim was pulled out flat and smoothed with a piece of metal called the *trencher*. While firmly secured on the block the hat was put in the coloring liquid, and after washing, trying, and stiffening, it was finished by carding the outside when a long, flowing nap was wanted, or it was rubbed over with pumice-stone, when a smooth finish was desired. After the trimming had been put on, the hat was ready for use. All the various manipulations were done by one man who had learned the hatters' trade; and the separation of these, and the division of the hat-makers into *makers*, *blockers*, and *finishers*, did not become general until the *forming machines* had come into general use.

The first improvement in hat making was made by Mason, whose wool hat-body former consisted of a conical block upon which the web of wool was wound as fast as it was delivered from the carding machine. This machine was improved by Grant. See HAT-FORMING MACHINE.

At about the period of the introduction of the wool-hat forming machine, the hat-body *hardening* machine, with reciprocating rubbing board, came into use in hat factories. See HARDENING MACHINE. It consists of a cloth-faced rubbing board, which is rapidly reciprocated upon a pile of hat-bodies lying flatly beneath it, each hat-body having within it a hard cloth, and a cloth also interposed between each body. The pile lies upon the perforated top of a steam box, so that the whole of them are kept saturated with hot steam.

Sometimes a special machine is used to harden the tips of hat-bodies. It consists of a rubbing board acting upon the top of a steam chamber of such shape that the hat-body can be slipped upon it after the sides of the body have been hardened in the ordinary machine.

*Wells'* machine, improved by *Taylor & Burr*, is described under HAT-FORMING MACHINE. It may be simply stated here in a general way that it consists of an apron to feed the fur, a picker cylinder to loosen and scatter it, and a perforated revolving former or cone, beneath which is an exhaust fan. The fur fed in regulated quantities is finely divided by the picker and sent whirling in the direction of the cone, upon which it collects as the air passes through the interstices and the hairs collect on the outside.

With the more extended use of the machine for forming fur hat-bodies, it became necessary to have better appliances to separate the fur from the hair and to prepare it for the former. This was accomplished in *Rotch's* fur-blowing machine, in which the fur and hair are separated and other impurities removed. This consists of a feeding apron, pickers, and a screen. The fur is presented by feed-rollers to the picker, which combs it out and scatters it, the lighter part into an upper chamber, and the heavier into a lower one, where a screen separates the tussocks of imperfectly treated matter from the hairs and dirt. The latter are removed while the former are passed back to be re-treated. See FUR-BLOWING MACHINE. Fig. 1112, p. 332, *supra*.

After the forming of hat-bodies, both fur and wool, had been successfully accomplished, the sizing or fulling of hats received the attention of inventors, and numerous attempts were made to full hats, but only a few machines proved of any value. James S. Gaylor, of Danbury, Conn., however, invented and patented a four-roller sizing machine which came into general use in wool-hat shops. The hat-bodies were rolled up in a piece of cloth and put between four rollers, which were placed in a hollow casing with their axes at an angle with each other. This position of the rollers caused the roll of hats, which was introduced into the machine at one end, to travel slowly along while turning between the rollers, two of which have, in addition to their rotary motion, a slight vibratory motion sideways, and thus the hats were slowly felted. As stated above, this machine was extensively used in wool-hat factories, but it was superseded finally by the fuller mill, which is now universally used.

The first successful attempt at fulling hat-bodies was in the factory of the Seamless Clothing Manufacturing Co., Matteawan, N. Y., where the manufacture of wool hats was commenced about 1860.

Various styles of mills are now in use. One will be found under FULING MILL.

The batches of hats are placed in the bed of the machine, and are subjected to the blows of a beater driven by a crank, or to the pounding action of falling stocks, which are lifted by cams or trips, as the case may be. In some cases acidulated water is used in the bed to facilitate the felting, but generally fullers' soap is used. The fulling of hat-bodies in the mill is confined to hats of wool. Fur hats are sized on the *battery*.

Following in due sequence of history, we cannot omit noticing the advent of Kossuth in the United States, which made soft hats and flowing beards fashionable. The demand for soft fur and wool hats increased very rapidly, but the latter could not compete with the former until *T. Waring* introduced the hat-finishing lathe. Before this time the wool hat-body, after it had been sized, was rubbed off with pum-

ice stone, and afterwards put on a block to be ironed off and touched up with sand-paper. Waring made the hat-block with a chuck which fitted to a lathe spindle, and the operator, while the hat was revolving rapidly on the lathe, held sand or emery-paper on the hat, and thus finished the hat. The advances made in the manufacture of wool hats date from the introduction of this improvement. Prior to this time wool hats were made of the lowest grades, and could not compete with fur hats, but, by the use of the finishing lathe, it became possible to give hats made of the finer grades of wool a finish closely assimilating the appearance of the lower grades of fur hats, and from this time the wool-hat trade began to rival the fur trade. See HAT-FINISHING LATHE.

Shortly after the introduction of the finishing lathe, sewing-machines were first introduced to put the lining on the brim of the hat. See HAT-LINING SEWING-MACHINE.

Consequent upon this came the hat-sweat-rolling machine, which turns the edge of the leather sweat-lining in order to prevent its marking or hurting the forehead.

Next in order came a machine, invented by Eickmeyer and improved by Judson, to make the hat-lining. The tip is secured upon a table having a round or oval motion, while another piece is put in a folding gage in such a way that the stitching will fasten the edge of the piece that forms the side-crown in a circular or oval line to the flat tip. Judson added to this a pair of rotary trimming shears, and arranged the turn-table upon a swinging lever.

The pouncing machine, however, now finishes the insides of hats almost equal to the outsides, and crown-lining is almost discontinued in felt hats.

Another addition to the machinery in the manufacture of hats is that used to put the stiffening into the hat-bodies. To give the bodies a permanent shape, some stiffening material is generally put into the body; in the better class of hats a solution of shellac; in those of cheaper character, Irish moss, glue, etc. The solution is put into a trough under a pair of rollers which are geared together and driven by a belt from a line-shaft. Two troughs and two sets of rollers are generally mounted on one frame, one trough containing a thin solution into which the whole hat is plunged, and the surplus matter pressed out by passing up the hat-body between the rollers. The other trough contains a heavier solution into which is dipped that part only of the hat which is to form the brim. The troughs are heated by steam to keep the stiffening in a fluid state, and the hat-bodies, after being stiffened, are ready to be blocked.

Up to this time the hat-body is yet of a conical shape; forming, hardening, fulling, and stiffening have followed each other *seriatim*; this series is in the case of the wool hat-bodies only. It has been already explained that the operation with fur bodies is upon a special set of machines.

The blocking of the hat-body is that part of the manufacture in which the cone-shaped hat-body is pulled out around the edge to develop the brim, and the upper part is widened out to form the flat tip and the side-crown. This is described under BLOCKING MACHINE, pp. 109, 110, *supra*.

The machine of Fenn may be described in brief to have had two pairs of rollers, one pair traveling somewhat faster than the other. The edge of the conical hat-body being nipped between the rollers, the pair in advance pulled upon it faster than it passed through the hind pair and so stretched it. It was thus gradually flattened out so as to form a brim, but did not act upon the crown or tip, and as its action was slow and incomplete it only came into partial use.

The first complete machine for stretching hat-bodies, wool or fur, was the corrugation stretcher of Eickmeyer, and these machines, in various modifications to suit the different kinds of work, are now used almost exclusively in the hat factories of this country. Described and illustrated under BLOCKING MACHINE (Fig. 335, p. 109, *supra*), it need not be considered at length here. It has a ribbed and recessed former which rises vertically and pushes the hat-body into a cap which has a number of yielding levers corresponding in number with the recesses in the former. The edge-rollers on the ends of the levers push the felt into the recesses of the former and stretch it. This is repeated again and again, the hat being moved on the former between each operation. The brim and tip are thus developed.

Next in order comes the blocking machine to make the band, as the sharp angle formed by the junction of the brim and side-crown is known in the trade. This is done by a rising spindle which carries the hat on its block, in the first place against a clamping plate which holds the brim flat and then pushes the crown into a cylindrical banding shell whose lower edge forms the band or angle. See BLOCKING MACHINE, Fig. 337, *et seq.*

To adapt the principle of stretching by corrugation to fur hats a number of modifications were required. It was found advantageous to separate the brim stretcher from the tip stretcher, and to substitute round-edged bars for the round-edged rollers.

These machines are considered in their places. See BRIM STRETCHER, Fig. 427, p. 135, *supra*; TIP STRETCHER, *infra*. Eickmeyer's finishing blocking machine, known as a hat-

shaping machine, is considered and illustrated under SHAPING MACHINE. The hat placed upon an expansible block (which has been previously contracted to its smallest diameter) and a circular series of 38 tongs is made to grasp  $\frac{3}{4}$ " of the edge of the brim all round. The banding ring is thrown over the hat and locked fast. The edge of the brim being firmly held by the tongs, the operator raises the block and expands it to the desired size. The hat is then cooled and taken off, and the operation repeated on the next hat.

All the adjustments—size of band, height and diameter of crown, and width of brim—are made by gages attached to the different levers, so that the operator can set each part in a few moments, and all sizes of hats can be shaped on the same machine. A good operator will block from four to six dozen per hour. See SHAPING MACHINE.

The introduction of these machines for the stretching and blocking of hats has had a marked effect both upon the quality and facility of production of the hats so treated. When but imperfectly done, hats will in a short time lose their shape and "go to seed," as it is called in the trade, but when properly blocked on a machine, the felt is so well and equally stretched and shaped that the hat is much more durable.

Next in importance to the machine for blocking and shaping are the pouncing machines, for sand-papering the surface of the hat-body or the hat after it has been blocked.

The hat-finishing lathe, used in the wool-hat factories, was never successfully introduced in the fur-hat manufactures, owing to the fact that fur hats were usually made in small shops where power was not used, and also on account of the difference in the material.

The pouncing machines now in general use are constructed on two principles.

A rapidly rotating cutting or rubbing cylinder, which operates upon the hat-body or hat while it is fed along upon a yielding bed, is used in one class of machines. In the other class, a reciprocating motion is given to the cutting surfaces to rub in two directions.

For wool hats, and the lower grade of fur hats, the rotating cutter machines are exclusively used.

Under their own captions are described machines for pouncing hat-bodies, special machines for pouncing the brims, and for the crowns of the common grades of blocked hats, and also the reciprocating machine for the finer classes of felt hats. See POUNCING MACHINE.

The foregoing account comprises the most important machines used in the hat factories of the United States, but mention may be made of some machines used in the final finishing of the hat.

Joyce's hat-brushing machine is frequently used to remove the dust left in the hats by the pouncing machine.

Stewart's sewing-machine, adapted to sew ribbons on hats, has lately been extensively used in wool-hat factories.

Hydraulic presses to press hats into molds of proper shape, so extensively used in Europe, have not proved successful in this country, although a great many attempts have been made, and many machines patented by different inventors.

India-rubber blocks, made in the shape of the hat-block, have, however, been used in molds which surround the crowns only of the hats. See HAT PRESS.

Various styles of ironing machines are also in use, one of which is shown under IRONING MACHINE, which see.

But little improvement has been made in the finishing process of fur hats, and although many different machines have at times been used, and some with considerable success, none have been able to supersede hand labor. The use of the fulling mill to felt fur hats has also been frequently attempted, with but moderate success.

- See:—
- Rack, *Dorr* . . . . . \* "Scientific Amer.," xxxvii. 360.
  - Felt . . . . . \* "Scientific American," xl. 26.
  - Fireman's, *De Celis* . . . . . \* "Scientific Amer.," xxxviii. 407.
  - Forming machine . . . . . \* *Laboulaye's "Dict.,"* etc., cap. "Chapeau."
  - Making machinery . . . . . \* "Scientific Amer.," xxxiv. 50.
  - Press . . . . . \* *Laboulaye's "Dict.,"* iv., cap. "Apprêts."
  - Sweat . . . . . \* "Scientific American," xlii. 3.
  - Hat-trade of America . . . . . \* "Scientific Amer. Sup.," 2414.