

**HAT-MAKING MACHINERY.** The manufacture of felt hats in the United States has gradually become divided into two independent branches—the production of fur hats, made from the fur of the gray or white rabbit or hare, known in the trade as cony or Russian fur, and of wool hats, made from different kinds of wool. Very few hats are manufactured from a mixture of fur and wool, or with bodies of wool covered with fur. Although the methods of making fur and wool hats are apparently similar, yet the machinery employed differs so materially that both branches of the trade are rarely conducted in the same establishment.

**MANUFACTURE OF FUR HATS.**

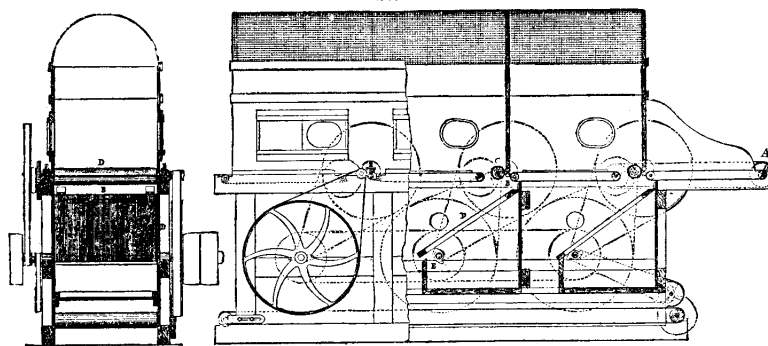
There are various ways of preparing fur for felting. Hare-skins are split open and rubbed with a rough knife-blade to remove bits of adherent fleshy matter. They are afterward dampened on the pelt side and pressed together pelt to pelt. Rabbit-skins are treated in a similar manner, except that the long hairs are pulled instead of being clipped. They are thus made ready for cutting.

*Cutting* is accomplished in a machine having a rapidly-revolving cylinder, in the periphery of which three or more knives are obliquely set, and which rotates in close proximity to a stationary bed-knife. The skin, resting upon the bed-knife, is divided into narrow strips, and is then cut away from the pelt, which is thus left in a continuous sheet. The fur is carried by an endless apron to a workman, who separates it into various grades and packs it in bundles.

Beaver and nutria skins require more care in their handling than do rabbit or hare skins. They are loaded with fat, which must be removed by soap and water, and they are subsequently treated with a dilute solution of nitric acid. This process also assists the felting properties. Skins that have been thus treated are said to be “carroted.” Thorough drying should follow. Hair is sometimes prepared in a solution of quicksilver and urine. All furs are more or less mixed with long hair, and for the removal of this the fur-blowing machine is employed.

The *Fur-blowing Machine* is represented in Fig. 2295. The material is spread upon a feeding apron *A*, and by means of two rollers *B* is presented to a rapidly-rotating toothed cylinder *C*. The motion of this cylinder creates an air-current, which carries the lighter particles of the fur upward

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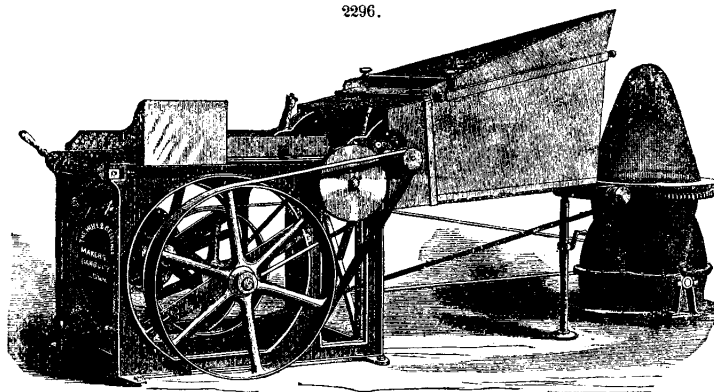
into a chamber which is closed by a fine wire screen, through which the air escapes, carrying the finer particles of dust with it. The hair and coarse particles fall upon a wire screen, which is vibrated by a cam *E*, and thence pass upon an apron, which delivers them under the feed-apron. Another feed-apron forms the bottom of the chamber into which the fur passes; and as the fur settles on this apron it is conducted to a second pair of feed-rollers, which carry it to another picker-cylinder, where the operation already described is repeated.

Most fur-blowing machines contain from 5 to 8 picker-cylinders, the fur being delivered in an endless sliver to the last pair of rollers. Hair and impurities which pass through the screen are collected. Fur which does not pass through is carried back by an apron and subjected again to the action of the machine. This operation is continued until the quantity of hair is reduced as much as

is possible. In forming the hat-body various kinds of fur are mixed in an apparatus which contains a picker-cylinder, whereby the fur is loosened and thrown into a closed room, or into a machine similar to that above described, by which it is delivered in a continuous bat. The fur thus prepared is weighed and separated into portions, each of which is sufficient to form one hat-body.

*The Forming Machine.*—The apparatus generally in use is that invented by H. A. Wells in 1846, and since greatly modified and improved by Taylor, Burr, and others. In the Wells machine the fur is conducted to a forming cone by an adjustable trunk, while in other machines, such as that devised by Gill and Taylor, it is thrown into a case which surrounds the former-cone, and is conducted to the cone by an air-blast from a blower beneath. Fig. 2296 represents a Wells machine of late construction. An apron and two small feed-rollers deliver the fur to a rotating picker-cylinder. The air-current caused by the latter carries the fur to the mouth of the trunk. The size of the aperture is adjustable to correspond to that of the cone used. The cone is made of perforated sheet-copper, and is placed upon a revolving table, in the centre of which is an opening communicating with an

2296.



exhaust-fan, by means of which an air-current is drawn in through the perforations, so that the fur is thus caused to be deposited over the surface of the cone. This process continues until all the fur set apart for one hat-body is thus deposited. Over the material a wet cloth is wrapped, and over this again a tin cover is placed, when the whole is removed and dipped in hot water in order to give the felt a sufficient consistence to allow it to be removed from the cone.

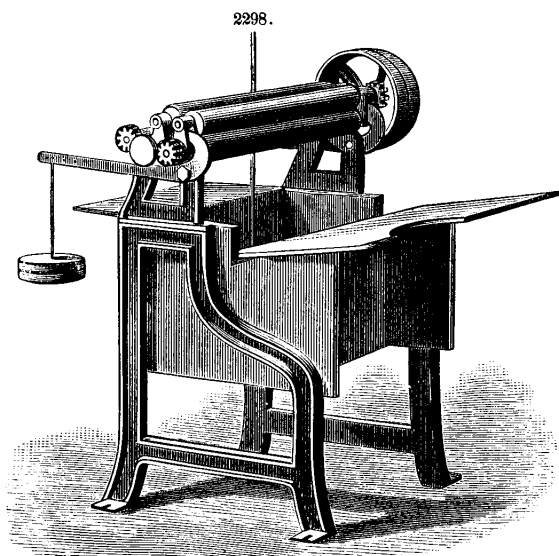
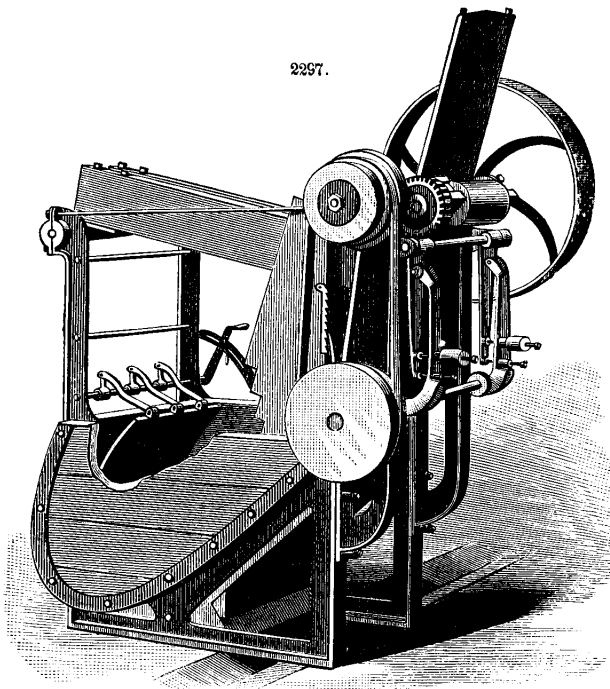
Hardening the felt, which follows, is done by placing six or more of the felt-cones formed as above one upon the other, wrapping them in a wet blanket, and rolling them back and forth by hand on a smooth board.

*Sizing.*—This name is given to the manipulations by which the felt is reduced to the proper size for hat-making. Up to a very recent date (1879) this work was done, and is still largely performed, entirely by hand. Three or four hat-bodies are dipped into boiling water (sometimes slightly acidulated), and then are wrapped in cloths, making a bundle some 4 inches in diameter. The bundle is rolled to and fro on an inclined plank, and the pressure of the hands is carefully graduated to the consistence of the hat-body. After being rolled for a short time, the bodies are separated and placed together again in different position, so as to prevent their sticking together. As the process continues, the roll is made tighter and the pressure increased, until the body has attained the desired size. The felt is then "pinned out"—that is, smoothed and tightened by pressure with a rolling-pin and frequent dipping in hot water.

The machines used for this purpose are the invention of Mr. R. Eickemeyer of Yonkers, N. Y., and are modifications of the fulling-mills used in the manufacture of wool hats. The bodies after leaving the former are placed first in pusher-crank mills. These mills have a single pendulum-beater suspended from the top of an iron frame and operated by a bell-crank, which receives motion from a crank on the main shaft. The wrist-pin on the bell-crank is adjustable, so that the force with which the bodies are pushed against the curved part of the bed may be graduated. This operation is continued until the felting has progressed far enough to allow the hats to be placed in the fulling-mill proper, Fig. 2297. This machine has a single beater pivoted to the front of the frame. On the opposite end is a horizontal driving-shaft, which makes 120 revolutions per minute. In the middle is a gripping-roller, against which a lifting-board attached to the end of the beater-handles is at regular intervals pressed by another gripping-roller journaled in a swinging frame. A stepped pulley on the driving-shaft communicates motion to a second shaft, on which are cams which actuate the swinging frame. The speed of this shaft determines the period of lift and drop of the beater. The amount of lift and drop can be regulated from 50 lifts 8 inches high per minute to 38 lifts 20 inches high per minute. The fulling-bed is formed of two pieces of metal hinged at the base, the lower portion being perforated to allow entrance of steam during the fulling process. The front portion is hinged to the stationary part, and is connected by links to a rock-shaft and lever which enables the operator to increase resistance to the movement of the hat-bodies. When the mill is first set in operation, the beater is adjusted to a fall of about 8 inches, and is run at the rate of 50 blows per minute, care being taken that the position of the hats is constantly changed. As the fulling progresses the front is lowered, and the fall of the beater increased and its rapidity reduced, until at the end the fall becomes fully 20 inches and the blows 38 per minute.

After being fulled, the hat-bodies are passed while hot through a pinning-out machine, Fig. 2298, in order to tighten the felt and smooth them. This apparatus consists of two pairs of rollers, one pair having rigid bearings, the other being pivoted in weighted levers. The upper pair of rollers is slightly the larger in diameter, and all revolve at the same uniform speed. Through these the body, after being dipped in hot water, is passed. The diameter of the lower rollers being less, however, than that of the upper ones, the hat-body is drawn out between them, and the felt at the same time is rendered compact and free from wrinkles.

*Sizing Machines.*—Numerous attempts have been made to construct sizing machines to supplant the hand-sizing process. The machines operate upon a limited number of hats, rolled in a cloth and kept in motion by rollers which have a vibrating movement. In one class of machines these rollers are irregularly ribbed to press successively upon different parts of the hat. The machine devised by Mr. J. S. Taylor of Danbury, Conn., in 1853, has four rollers, so journaled in their frames that their axes are inclined to the centre of the hat-roll, and one pair of rollers has a vibrating motion in addition to its movement of rotation. In the machine devised by Mr. J. W. Blackham of Brooklyn, N. Y., a number of slowly-revolving rollers form a bed over which is placed a yielding cover, having a vibrating motion in a direction at right angles to the axes of the rollers. The hat-rolls are passed between cover and bed



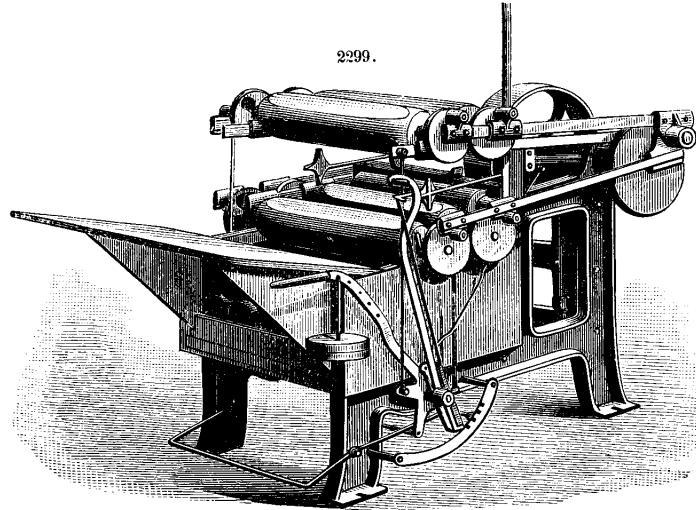
several times. It has not been found profitable to begin sizing the body by machinery as soon as it leaves the former, and hence the present practice is to size the body by hand until it is within an inch of its desired dimensions, and then to complete the work in the sizing machine—or, as it is then termed, the second-sizing machine.

A machine adapted to this second sizing has been devised by Mr. J. Vero of Dewsbury, England, and improved by Kirk, Shelmerdine, and Froygate, of Stockport, England. The improved apparatus has four rollers driven all in the same direction by gearing. The lower pair of rollers is journaled in the stationary frame, while the upper pair is journaled in a swinging frame, which can be lifted up whenever the hat-roll is to be inserted or removed. The working surface of the rollers is formed of elliptical rings, made of India-rubber, and placed so as to overlap each other. Generally, two rolls of hats are kept in operation,

one roll being acted upon while the positions of the hats in the other are being changed.

Fig. 2299 represents a machine of this class. Two beaters act upon the ends of the hat-roll. Four cubical pressers are provided, so arranged that the hat-roll is pressed at each quarter revolution of the pressers. These are journaled upon two swinging frames, which are so connected by links to

levers in the rock-shaft that, while balancing each other, the pressers can be separated to take out or insert a hat-roll, or be brought together by a weight on the hand-lever. The pressers are actuated from the main shaft, two cams on which operate the beaters. On each beater is a projection, to which an adjustable spring is attached in order to graduate the blow upon the hat-rim. Devices are provided whereby the spring may be held at any tension suitable to the condition of the bodies. By

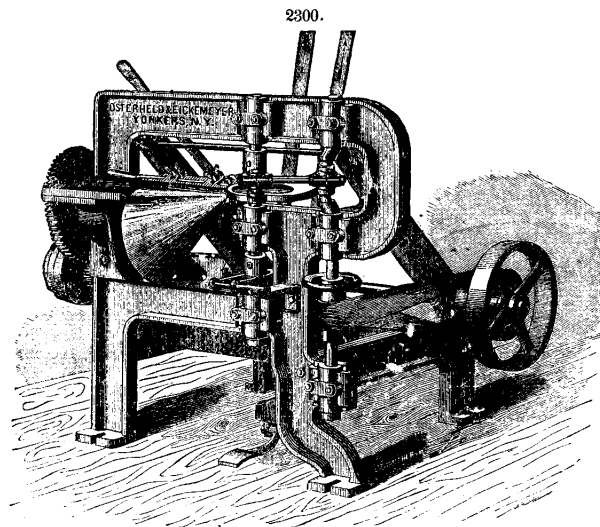


a gradual increase of the weight which presses the rollers or pressers together, and a similar increase of the tension of the beater-spring, the action of the machine is adjusted as the felting progresses.

Some grades of hats are sheared before the sizing or felting is finished, in order to remove long hairs. Eickemeyer's machine for shaving hats is represented in Fig. 2300. The hat is placed on a padded board of the same shape as the body, and a knife is caused to vibrate rapidly over the surface of the latter while the feeding mechanism draws the hat along, slowly rotating it. The best

speed of the knife is from 600 to 650 strokes per minute, and from 3 to 6 dozen hats can be shaved without change of knife.

*Stiffening the hat-body* is the next process. After drying, the felt is dipped in an alkaline solution or one of shellac. Stronger solutions are used for the brim than for the crown of the hat. Passing between weighted rollers follows, the surplus stiffening material falling back into the tank to which the rollers are attached. The body is folded and rolled several times, until the stiffening solution is evenly distributed. The brim is stiffened afterward, and rolled in similar manner. Some manufacturers prefer to apply all the stiffening after the body has been blocked and colored; while others only partially apply stiffening in advance, reserving the completion of the process until after block-

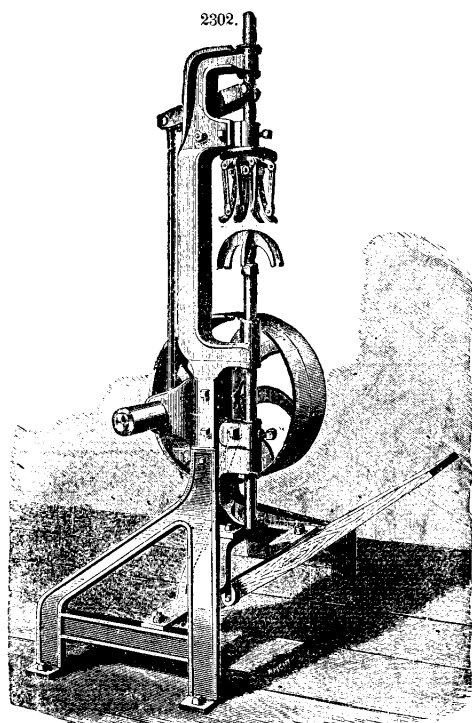
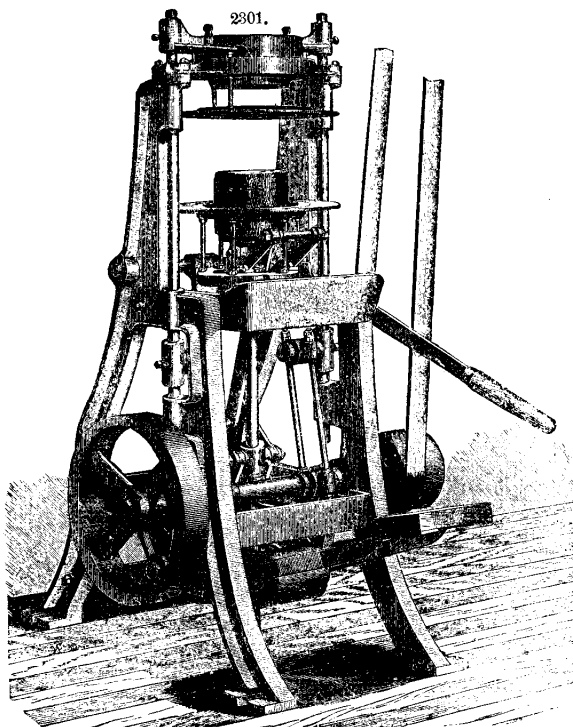


ing. After stiffening, the body is steamed, and is then ready for the initial shaping processes.

*Stretching and Blocking.*—The hat-body has now reached a point where it begins to assume a semblance of the completed article through the development of the tip, side-crown, and brim. Many attempts have been made to accomplish shaping by machinery. The first United States patent was granted to Mr. D. Beard of Guilford, N. C., in 1816, for a machine for stretching hat-crowns. Other devices have subsequently been invented and come into limited use; but it appears that the practical difficulties were not successfully overcome until the invention in 1865 of the hat-stretching machines of Mr. R. Eickemeyer. In previous apparatus the effort was to stretch the hat-body from the centre; in the Eickemeyer machines the body is stretched over a ribbed and recessed former,

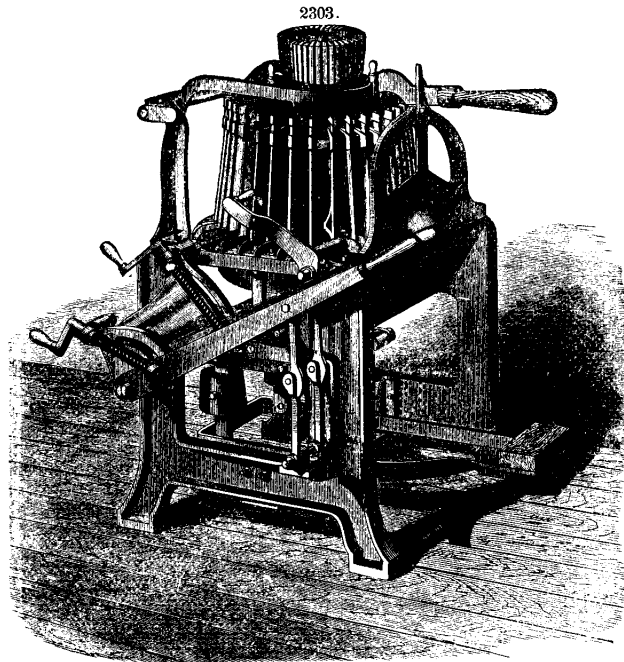
and is thus drawn out radially, the centre being widened at those parts which form the crown and brim of the hat. The former is secured to a sliding spindle, which is actuated by a treadle and link. Directly over and in line with the spindle are suspended adjustable stretching-fingers. When these are brought down by means of a hand-wheel connected with their spindle, they are closed in around the hat-body, and their pressure is increased. To suit hats of varying diameters, a star is fastened upon the spindle. The hats to be stretched are first soaked to render the felt pliable, then placed upon the star, and forced down upon the stretching-fingers. This operation is repeated five or six times. At each motion the height to which the body is lifted and turned, to bring the stretcher in contact with all parts, is increased. Usually two hat-bodies are stretched at a time, both being turned inside out so as to protect them against injury through contact with the stretching-fingers.

The brim-stretcher is represented in Fig. 2301. This consists of a series of expansible ribs mounted upon a sliding spindle in the centre of the machine. Connected with the spindle is a system of links and levers operated by the treadle, by which means the spindle is caused to rise, and so bring the ribs into working position. Above the ribs is a hat-block which can be adjusted to any height. The stretching-fingers are so arranged as to be automatically reciprocated toward or from the centre of the machine.



The outer ends of the fingers are connected by short links to a ring fastened to two upright sliding bars, which have their bearings in the side frames of the machine, and receive motion from the crank on the main shaft. The crank-shaft makes from 300 to 350 revolutions per minute, producing the same number of vibrations of the stretching-fingers. The hat-body is adjusted upon the block, the treadle is depressed to its full extent, and the hand-lever on the right of the machine is raised. The ribs upon which rests that portion of the body which is to form the brim are spread out between the vibrating fingers. After 10 or 15 stretches are made by the fingers, the block is lowered sufficiently to turn the hat upon it, so as to bring the fingers upon that portion which previously rested on the ribs, and the operation is repeated. From 30 to 40 vibrations of the fingers are usually sufficient to stretch the brim to its full extent.

These machines differ considerably in construction, according as they are applied to different uses. Fig. 2302 represents the Eickemeyer fur-tip stretcher. In this the fingers are mounted on a spindle which has its bearing in line with the sliding spindle which supports the star. To this spindle a short walking-beam, which also communicates with the crank-shaft, is hinged. Each revolution of the main shaft thus causes vertical movement of the spindle, and also of the stretching-fingers. In practice the best results are obtained at from 100 to 150 revolutions of the main shaft.

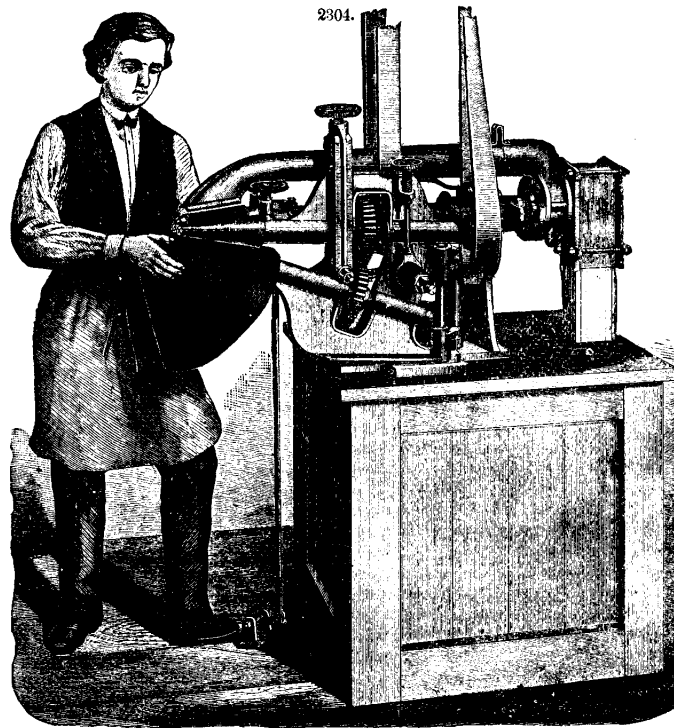


*Blocking.*—Fig. 2303 represents the Eickemeyer hand hat-blocking machine, which operates as follows: A hat previously stretched on the tip, side-crown, and brim is clamped on the outer edge and expanded to the desired size. Thirty-six clamping-tongs are pivoted to the top plate, in an oval line around the block, and these are attached to the foot-lever so as to move outward from the centre when the lever is depressed. Each one of the clamping-tongs is also connected to a clamping-lever, so that all may be simultaneously drawn upon the brim placed between them. An adjustable block composed of 48 pieces, which are also spread out from the centre by one of the levers shown, is mounted on a sliding spindle, and can be raised or lowered. To form the band of the hat, a ring of the exact size and shape is suspended from the hand-lever, which is pivoted horizontally

to brackets. Adjusting-screws are provided for regulating the height and diameter of the crown, and "brim-tongs" govern the exact width to which the brim is to be drawn out.

The operation of blocking is performed as follows: The upper or banding lever having been

raised, the block is contracted and lowered, and the clamping-tongs are closed in. One or two hats, having been thoroughly heated in hot water, are placed upon the block, the brim resting upon the heads of the clamping-tongs, which are now expanded sufficiently to allow the edge of the brim to slip down upon the lower jaws. The tongs are then made to approach the hat until the edge of the brim touches the upper jaws all around, when the clamping-lever is pulled forward, and all the upper jaws are closed upon the brim, which is thus firmly held and slowly expanded to full size. The hat-block is in the mean time raised and the banding-lever lowered; and after the block has been expanded, the workman gives the banding-lever rapid up-and-down motion to form the band. The hat is then cooled in place by cold water, when it sets in proper shape. From 50 to 80 dozen hats can be thus blocked per day. The hats are next washed and colored, and usually blocked a second time. They are then ready for the pouncing machine.

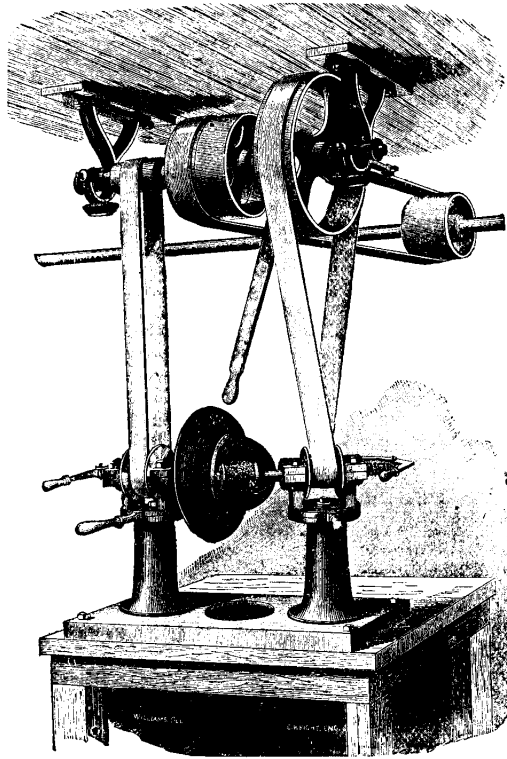


*Pouncing Machines.*—Various forms of these machines are used. In one of the simplest the hat is subjected to the scraping action of a rapidly revolving cutting-cylinder. In another, the abrading material is sand- or emery-paper secured to vibrating arms. In a third, the hat is fastened to a block which turns to and fro around its centre, while the rubbing material is held up to its surface. The first-mentioned machine is best adapted for coarser grades of hats, the others being preferable for hats of fine quality. Fig. 2304 represents the Universal pouncing machine, by means of which a hat-body which has not been blocked is pounced. A conical roller covered with fine sand- or emery-paper is secured to a horizontal shaft, and makes from 2,000 to 2,500 revolutions per minute. Conical feed-rollers, one of which in Fig. 2304 is shown as pressing upon the hat-body while the other is in the inside of the latter, have their bearings in two frames hinged to the main frame. These may be adjusted nearer to or farther from the cutting-roller, as well as longitudinally in the direction of the axis of the cutting-roller shaft, so that hats of any shape may be operated upon. The relative positions of the feed-rollers may also be varied so as to press harder at any desired point. The hat is supported on a horn hinged to the main frame, and is kept in working contact by the attendant pressing upon the treadle shown. A small exhaust-blower serves to remove the material abraded or cut off. The machine just described is chiefly used for pouncing brims, the side-crown and tip of the hat being operated upon in another apparatus.

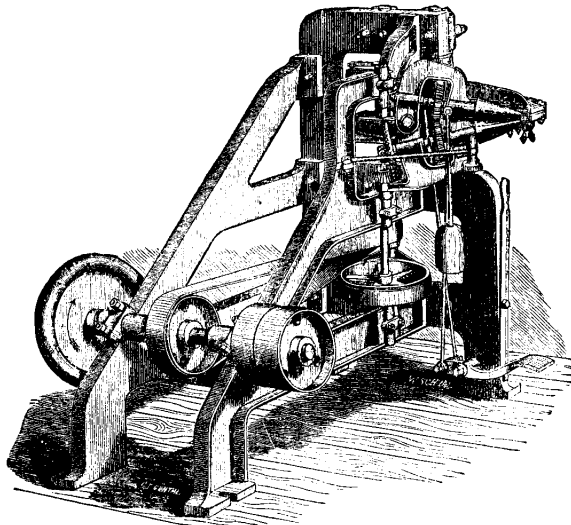
Fig. 2305 represents the Labiaux crown-pouncing machine. Two spindles are provided, one of which has a hat-block secured on its inner end, while to the other the cutting-cylinder is fastened. These have their bearings in lathe-heads mounted centrally upon and pivoted to short columns, which can be turned around by suitable handles. Both spindles slide longitudinally in their bearings, and in the flanged pulleys which give motion to them. A fast motion is given to the cutting-spindle, and a comparatively slow one to that which carries the block. After the hat has been tightly drawn upon the block, the machine is set in motion, and the spindle of the block is turned on its column until the tip of the hat touches the cutting-roller; the block is then turned slowly back while the cutting-roller is pressed against the surface of the hat, and is slowly passed over the square side-crown and tip, often two or three times to produce the necessary smooth finish. This machine is in some establishments used only for rough work, fine pouncing being completed on the apparatus illustrated in Fig. 2306, and known as the Rosekranz brim-machine.

In this device two vibrating rubbing arms are pivoted to a heavy frame, and actuated in opposite directions from an upright crank-shaft. Each arm has on its outer end a plate covered with sand- or emery-paper. The upper arm is attached to the treadle on the right of the machine, and can be

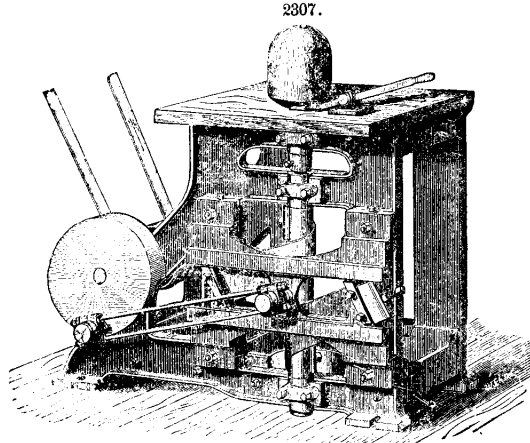
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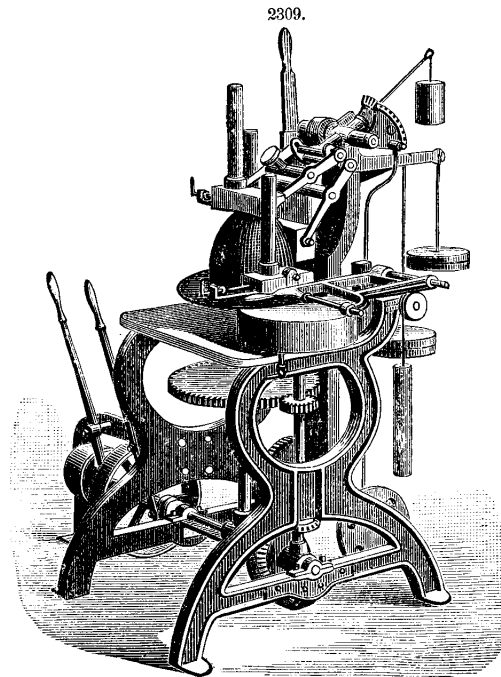
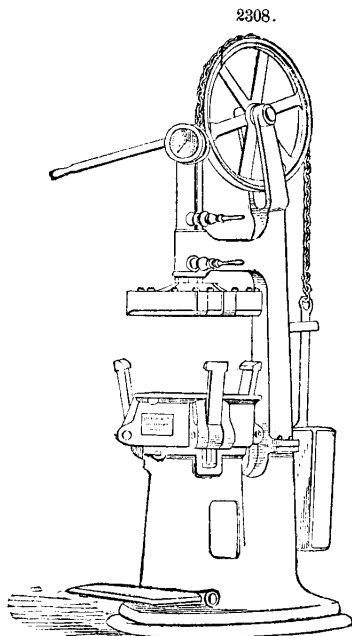
raised to introduce or remove the brim of the hat. A swinging frame contains the shafts of the two conical feed-rollers, the upper one of which is raised when desired by the treadle; otherwise the weight shown presses it upon the hat. The rollers receive motion from the upright shaft in front of the machine, through a system of bevel-gear. To regulate the motion of the hat circumferentially, the rollers can be set close to the rubbing plates, or for wide brims they may be moved farther away.



Means are provided for holding the treadle down, and thus keeping the rubbing surfaces and feed-rollers apart, when the machine is in motion but doing no work. The feed-rollers, first grasping the brim, give it a slowly rotating motion, and the rubbing plates when closed act against both sides of it. This produces a smooth and even surface.

To pounce the crown, it is necessary to place the hat over a block. A machine for crown-pouncing is represented in Fig. 2307. An upright spindle, which has its bearing in the frame, communicates with the sliding head, by two straps which are fastened to opposite ends of a cross-head, and also are wrapped in opposite directions around the spindle, and are attached one near the upper, the other near the lower bearing of the latter. The cross-head is connected by rods to the wrist-pin on the

fly-wheel. The motion imparted to the cross-head through the connecting-rod is transmitted through the two straps to the spindle, and produces two revolutions of the latter, first in one and then in the other direction, to each turn of the driving-shaft. The block for the reception of the hat is secured upon the upper end of the spindle, and may be removed by means of the small hand-lever shown. The rubbing material is held against the crown by hand, and is slowly carried all over the surface.



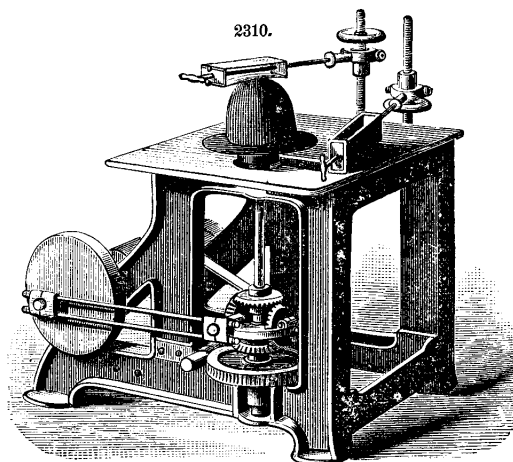
*Finishing Hats.*—The finishing of fur hats includes the final blocking, the shaping, ironing, and smoothing. Soft hats are first drawn over a block of the desired shape. The brim is then flattened out, and while damp the hat is ironed all over. Rubbing with fine sand-paper follows, and then several repetitions of the wetting and ironing for fine goods, or only two ironings and wettings for inferior grades. To give the hat a velvet finish, it is ironed first, then carefully rubbed over with fine sand- or emery-paper, and finally held over a jet of steam which raises the nap. It is afterward singed.



Stiff hats are differently treated. The hat is first steamed on a block, the brim flattened, and the surface rubbed with emery-paper. The brim is then cut to the right width, and the binding is put on. The brim is next to be curled, and for this purpose it is placed upon a convex plate heated by steam. This softens the brim, so that it can be turned over toward the crown and ironed down, forming a fold or roll gradually widening from the front and rear to the sides. The brim is then bent to any shape or curve, according to the prevailing fashion. To shape a stiff felt hat properly is the most difficult part of its manufacture.

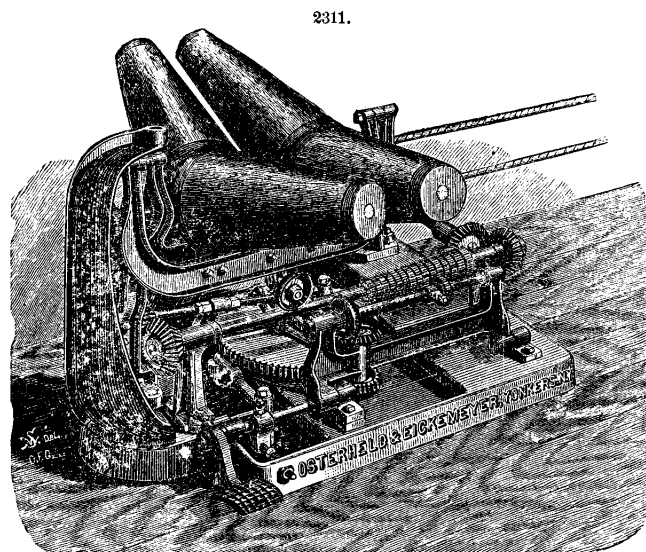
Hydraulic presses have of late been used with some success in pressing stiff hats. The hat is heated in an oven by steam, and is pressed either in a cold mould or in a hot one, to shape the crown and flatten the brim. In one machine of this kind, the hat is placed in a mould and an India-rubber cover is closed over it. This cover or diaphragm is expanded and pressed against the hat by water forced between the diaphragm and a stationary head by a pump. A press manufactured by Mr. George Yule of Newark, N. J., is represented in Fig. 2308. It consists of a heating chamber in which the hat is placed upon its block. The press-follower is driven down by the piston of the hydraulic cylinder, and is balanced by the counterweight shown. A pressure of about 300 lbs. is usually applied.

*Ironing Machines.*—Fig. 2309 represents an improved ironing machine which operates upon all parts of the hat. Its action is entirely automatic, one operator being able to attend to two or more machines. The chief improvements embodied consist in the attachment of side-crown and tip irons to a vibrating arm, to enable the latter to iron the square of the hat, and the introduction of a fast-running ironing disk to iron the under brim. The hat, secured on the finishing block, is placed on an upright shaft which revolves slowly. Another upright spindle, situated about 10 inches to the right of the first, has a disk fastened to its upper end, which is heated by a Bunsen gas-burner. This disk revolves about four times as fast as the hat-block, and in the opposite direction. Its flat side, which acts as an iron for the under brim, is adjusted level with the under side of the hat. A traversing motion is imparted to the tip and side-crown irons, so that they move from the centre of the tip and side-crown to the square of the hat. The device for ironing the upper brim is suspended in



a hinged lever, and is held by a weight up to the hat-block. In operation, the upper brim-iron is placed upon the brim; and as the friction of the latter on the iron has a tendency to draw the brim along, while the fixed upper iron retards this motion to the same extent, no wrinkling of the material is produced. The tip and side-crown irons are arranged to follow the irregular shape of the block. The traverse motion is then started, and the irons move to and fro, thus completing the smoothing of all parts of the hat.

When sufficiently ironed, the hat is placed in a pouncing machine, Fig. 2310, on a block which is mounted on an eccentric chuck, which has a reciprocating as well as a rotary motion. Rubbing with sand- or em-

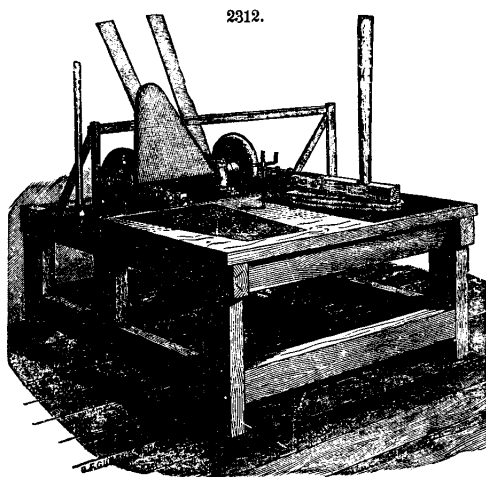


ery-paper follows, and then another ironing; and finally, if a velvet finish is desired, the hat is singed.

#### MANUFACTURE OF WOOL HATS.

The machinery used for preparing wool for hat-making is the same as that employed in its preparation for spinning. (See WOOL MACHINERY.) The former used for making the hat-bodies is

placed in front of the carding machine, and the sliver is wound upon a double cone, making two hat-bodies at a time. These are divided and removed from the cone when a sufficient quantity of material has been gathered. The wool-former is older than the fur-former, and it remains substantially as it was patented by Mr. J. Grant in 1827, all modifications tending to make its parts more adjustable and to increase their durability. The machine is represented in Fig. 2311. It is constructed so as to be easily adjustable to suit the largest size of man's or the smallest size of child's hat. Arrangements are provided whereby an equal quantity of wool is wound on both sides of the former-

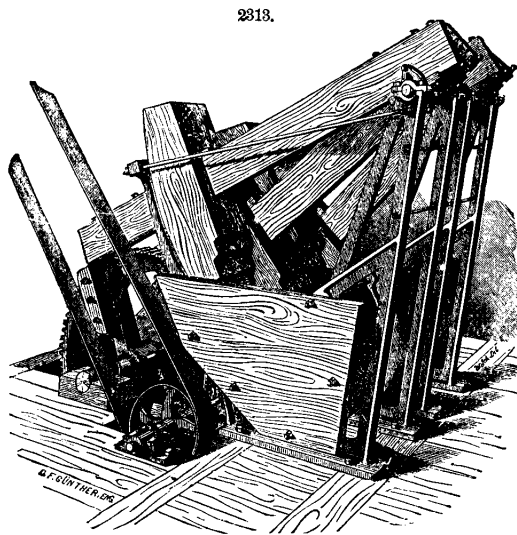


cone. The speed of the latter is regulated by shifting a small spur-wheel on the countershaft, which has its bearing in a swinging frame on the side, and is parallel with a series of gear-wheels of varying diameters keyed upon the main driving-shaft. Another improvement is the arrangement of a stop-motion to arrest the movement when the former-cone is parallel with the carding machine. When a large quantity of wool is to be wound on the cone to form a heavy brim, it is necessary that the machine should stop in proper position, and this is effected by the automatic devices provided.

*Hardening.*—Fig. 2312 represents a double hardening machine. A board of a hat-body when flattened out is connected with an adjustable wrist-pin on the fly-wheel. Steam-boxes of the shape of the body are set in the top of the table, and are perforated for the passage of steam. A piece of cloth is inserted in the body to separate the sides, and several bodies thus prepared are superposed. The engraving shows

one of the boards resting upon two hat-bodies and held down by a post, which presses it upon the bodies with sufficient force to compress them to a thickness of about a quarter of an inch. The rapid vibration of the hardening board upon the hats renders the material sufficiently tough to stand the action of the fulling-mill. After one side has thus been hardened, the bodies are removed and refolded, and the operation is repeated.

*Fulling.*—The first operation of fulling is conducted in a crank-mill essentially similar to that described as for fur hats, but which has two beaters acting in opposite directions on one fulling-bed. The hats are here fullled with fullers' soap. Afterward they are placed in the mill represented in Fig. 2313. Four cast-iron frames fastened upon a solid foundation support the shafts upon which the hammers are pivoted, and also the fulling-bed, which is divided into two compartments. The hammers are lifted by toes on the two large gear-wheels, one of which is shown in the engraving. The capacity of these mills is from 20 to 25 dozen hats fullled in from 24 to 48 hours. The hammers are lifted in succession and drop upon the goods, which are slowly turned. In some cases steam is admitted into the mill. After fulling, the bodies are washed in a crank-mill, and are then ready to be stretched and blocked, or stiffened and then stretched and blocked, as the goods may require.



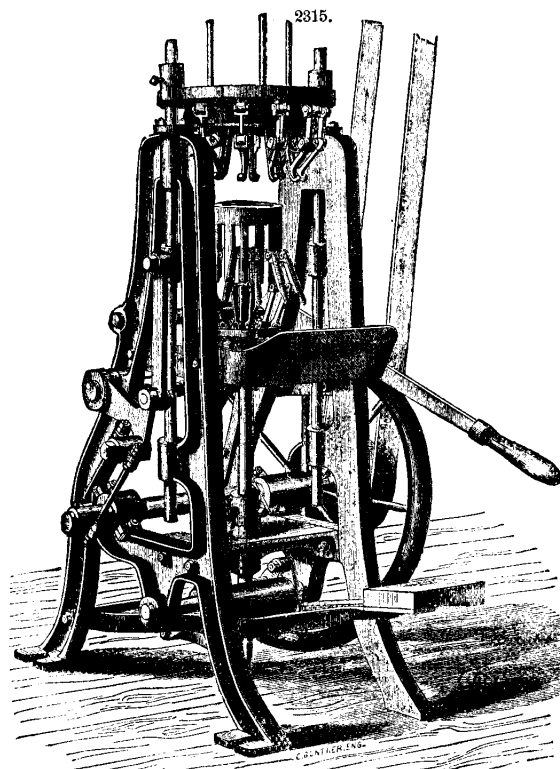
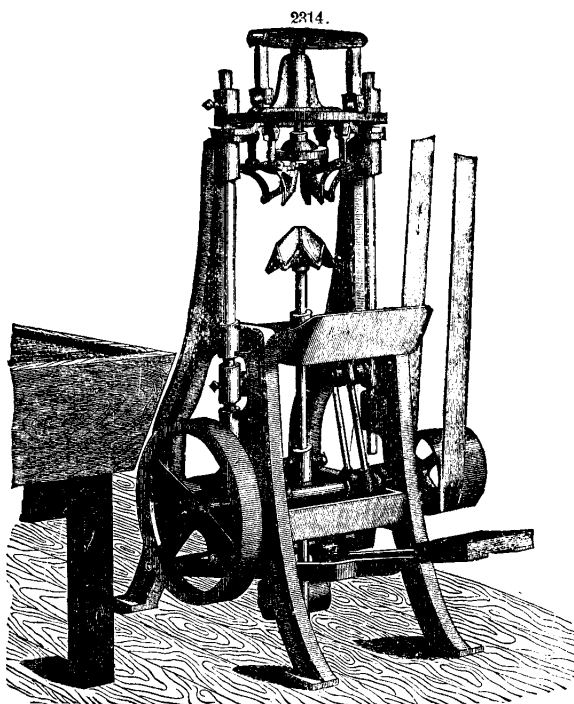
*Stretching and Blocking.*—The Eicke-meyer tip-stretcher, already described under fur hat manufacture, is largely used for this purpose. A special machine has however been devised, which is illustrated in Fig. 2314. This apparatus has a former of peculiar shape. The ribs which support the tip are connected, and the stretching-fingers are formed at an obtuse angle on the line where they come in contact with the body. Each finger is hinged at its middle to a disk, which is attached to the upright cylinder fitted in the upper cross-piece; and on its outer end it is secured to a ring which is held by set-screws to the two sliding rods in the side frame. The ring is actuated through connecting-rods by the crank-shaft, and thus caused to make an up-and-down movement at each revolution of the latter. The walking-beam on top of the machine is attached on its left end by a link to the cross-piece, at its middle to the cross-piece which carries the sliding fingers, and at its right-hand end to the vibrating ring. This connection gives to the disk an up-and-down travel of

about half the length of that of the ring. The fingers, as already stated, being hinged to the disk and ring, thus have at their lower extremities a movement to and from the centre of the hat, while they remain stationary at their point of meeting above. The effect of this is that the hat-tip is stretched peripherically only, and not radially in addition, as is done on some other machines. Each one of the vibrating fingers works in a recess, into which a portion of the felt is drawn at each vibration; and as the body is supported all around, a portion of the crown as well as the tip is drawn out. From 100 to 120 dozen hats per day can be stretched on this machine.

From the tip-stretcher, the hat-body is taken to the power brim-stretcher, and then while hot is placed on the blocking machine. This apparatus, represented in Fig. 2315, differs chiefly from other machines of its class in the operation of the banding-ring. To make a sharp edge at the junction of the brim and side-crown is the special object of blocking; and although the crown is also shaped, that part of the work is already done on the stretcher. The framing of the machine and the driving mechanism are substantially the same as in the power tip-stretcher just de-

scribed; but in place of a former, the brim is supported by an annular plate, which is recessed in the centre to receive a hat-block of the desired size and shape. Another plate is suspended by rods from the upper cross-piece. When the treadle is depressed, and the sliding spindle with the brim-plate raised, the hat-brim is clamped and held fast between the two plates. The driving-shaft gives a vibratory motion to the side-rods, to the upper end of which a cross-head with the banding-ring is attached. The banding-ring thus has a rapid vertical motion. When the hat is placed on the block, it is clamped. The block is then raised by a hand-lever until its under side is in the same plane as the hat-brim, where it is secured by hook-latches. The operator, while keeping his weight on the treadle, now removes the hat previously blocked while the band is formed in the hat in the machine. The treadle is then lowered enough to take off the hat and block, and is allowed to descend to its lowest position to release the sliding head upon which the block rests, and permit it to drop below the surface of the brim-plate, where it is held until the hat is removed by the hook-latches already mentioned. A set of machines, namely, tip and brim stretchers and blocker, working in succession, will block from 100 to 120 dozen hats daily.

The coloring, stiffening, and washing processes are the same as already



described for fur hats. The Eickemeyer pouncing machine noted in the same connection is also largely used. Two machines are however required, a right-hand and a left-hand machine, in order to produce a nap in the same direction on both sides of the brim. This is not requisite in fur-hat making, owing to the softness of the material. It is now necessary to remove all the fine dust from

the surface of the hat, and for this purpose the same machine is used. The cutting-roller is replaced by a cylindrical brush.

The treatment of wool hats in the finishing room differs from that of fur hats, in so far that the hat-body is always softened by a steam-jet when it is to be drawn on the finishing-block or shaping-flange.

*Finishing.*—Two methods are chiefly employed to give the wool hat its proper shape and finish. Hats with brims very much curved, and turned on the upper edge toward the crown, are first steamed, and the edge of the brim is secured to the periphery of a mould of suitable form. A second steaming follows, and the block is forced into the crown by means of a lever until its under side is even with the brim, which is thus drawn tightly over the mould. After cooling, the edge of the brim is cut, and the hat is then while on the block removed from the mould. The block is secured upon a rapidly revolving lathe-head, when the crown is first retouched with sand-paper, and finished by rubbing with a piece of felt by hand. This last is termed "ragging."

Hats with flat brims are first steamed on the finishing-block, and the band secured by a cord. The brim is flattened and ironed, and the hat is placed in the finishing lathe, rubbed with sand-paper, and ragged. Before the hat is trimmed, the crown (and, if flat, the brim) is pressed in a hot mould or on a hot plate. Fig. 2316 represents a hand-lever press used for this purpose. The hat is placed in a brass mould, and upon a hollow iron bed-plate heated by steam. By means of the cross-heads shown, the pressure upon the rubber diaphragm inside of the block is regulated. Usually three of these presses are placed in a row, and by the time a hat is placed in the last of the series, that in the first is pressed, and thus the work of pressing is continuously kept up.

In trimming hats, the principal machine to be noted is a sewing-machine which sews in the sweat-leathers. It is very ingeniously constructed, so that brims of any shape or curve may be introduced.

The large majority of the machines described in this article are the invention of Mr. R. Eickemeyer of Yonkers, N. Y., to whom we are indebted for the facts embodied in their description. G. H. B.

