EVOLUTION OF THE CALIFORNIA CLAM-SHELL DREDGER.

BY H. A. CRAFTS.

The dredger is an important factor in California's industrial development, creating new harbors, making unnavigable streams navigable, and reclaiming thousands of acres of swamp and overflow lands to the uses of agriculture.

Of the two principal types the suction dredger is used in harbor work, while the clam-shell dredger is found to be especially adapted to river and reclamation work.

While the suction dredger is a rapid worker, it has been found to be unsuccessful for levee or embankment work, as it delivers the material in a highly diluted state, and this is then liable to slough off. The clam-shell dredger, however, brings up its loosened earth in almost solid form and may be made to place it in the exact spot desired. In this way the embankment may be built up solidly, as the work goes along, with no waste of labor or material.

It has been estimated that the original swamp and overflow lands of California, located principally in the Sacramento and San Joaquin valleys, aggregate not less than a million and a half acres. Part of this ground, delta lands, is subject to daily tidal overflow, some to freshet overflow, and some to both. As the State is taking active steps toward the permanent reclamation of great tracts of this land, it is expected that the clam-shell dredger will be more in demand than ever. Even at the present no less than fifty machines are in constant operation.

The old-style levee was for various reasons built close to the channel by the old "wheelbarrow and scraper" method. It was also narrow and was constructed with an abrupt slope, both inland and on the water front. Time proved that this was not a wise course to pursue. The wash caused by the passing steamers was much more effective in breaking down the embankment than if the slope had been more gradual. This manner of dike was also found less able to withstand the force of flood waters; so the conformation of the California levee has been greatly modified as the years have passed and with the evolution of the clam-shell dredger.

The old-style clam-shell dredger was known as the turn-table dredger. The turntable was secured to a mast, and was operated with a winding drum, the turntable having two projecting arms, which spanned the boom about one-fourth of the distance from the pivot. It was also operated by a chain lift to the bucket with a compound set of hoisting blocks. The present-day or new-style dredger is operated with steel wires, which lead directly from the winding drums to the end of the boom, thence to the bucket, connected direct, without any blocks. This gives a better control of the boom, the pull from the end giving an increased leverage.

The old-style clam-shell dredger had a single frame forward, with only one center back leg, while the new-style one has a double set of forward legs and two legs to stern corners of the hull, thereby preventing the stern of the hull from coming up during the process of lifting.

The buckets of the old clam-shell dredger were of plate steel, hammered to the shape of clam-shells, with forged iron arms. The bucket of the present-day dredger is made of cast steel, with forged-steel arms. The shapes have been made the subject of long and profound study, and have been so designed as to give the best results in digging in hard material. The bucket at present in use will take out material that the old-style bucket would make but little impression upon. It has a maximum holding capacity of eight cubic yards of material. A machine of this capacity will handle from 3,000 to 4,000 cubic yards in a day of twenty-four hours.

In the day of the old-style dredger the levees were still steep and close to the channels, so that the booms seldom exceeded 90 feet in length. To-day, however, with the gradually sloping embankment, the booms in use are 125 to 150 feet long.

One of the larger type, now building, is a machine that will be provided with three-yard buckets and operated by a 140-foot boom. Each of these machines costs from $45,000 to $55,000, according to the character of the equipment.

THE MAKING OF A FELT HAT.

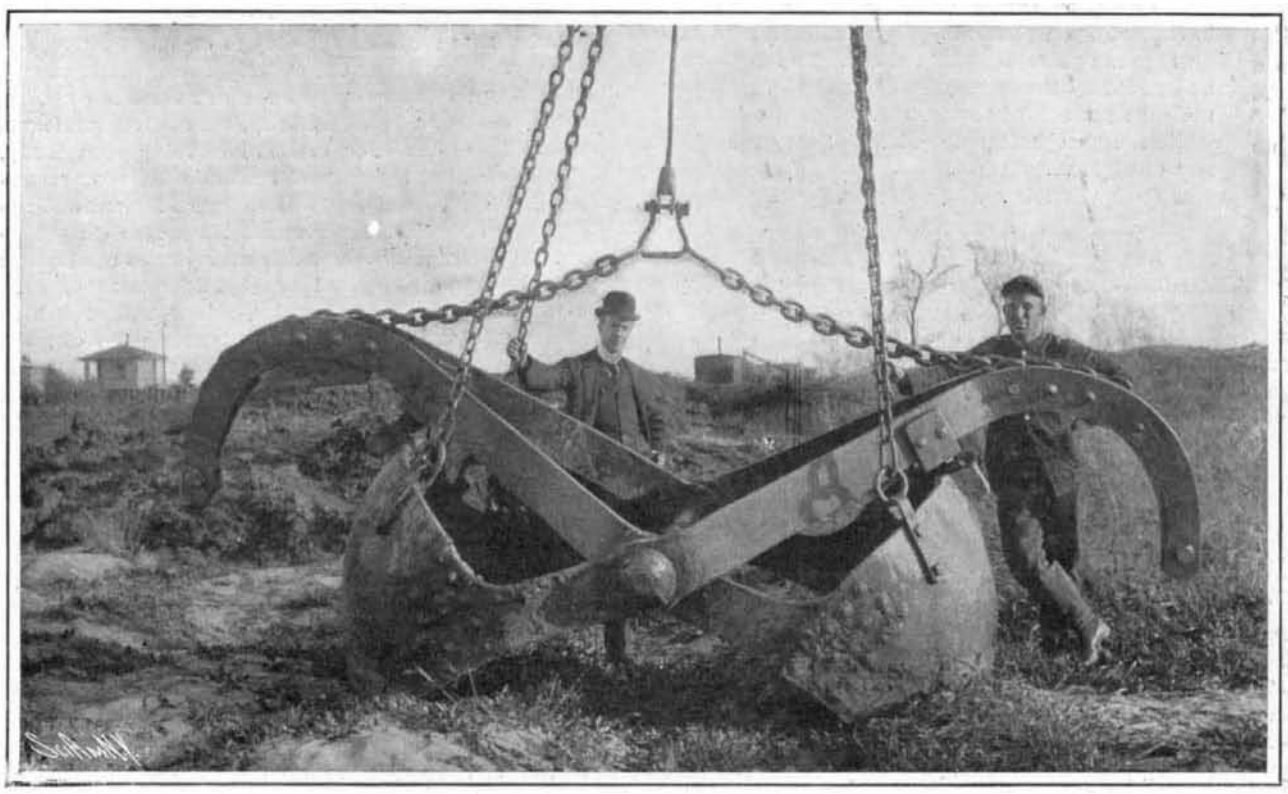
Generally speaking, felt is made from wool, hair, fur, or mixtures of these, by rolling, beating, and the application of pressure, often with the use of acid. The felting property of these substances is due to the fact that the fibers are rough in one direction only, for which reason they can glide among each other in such a way that, when the mass is agitated, the anterior extremities slide forward in advance of the body or posterior half of the hair and serve to entangle and compact the entire mass together. While considerable machinery has been invented and is used to a large extent in many felting processes, especially in the making of hats, skilled hand labor is still very commonly employed in many of the operations of the manufacture, though it must be admitted that the mechanical is constantly encroaching upon the territory of the manual, and it is now almost possible to make felt hats exclusively by machinery.

Many of the present-day uses of felt are beyond the scope of this article, which deals solely with the manufacture of felt hats—the ubiquitous derby and the tourist or Alpine hat. For this purpose, to-day, fur is almost exclusively used, the low price of this article almost entirely obviating the employment of wool even in the common and medium grades. Vegetable matter, with the exception of a little cotton thread or the backing for satin linings, has never been utilized in the manufacture. The furs most generally used are those of the coney, hare, nutria, muskrat, and beaver, in their various grades. The felting quality of the fur is affected by a number of considerations. That of newly-cut fur is inferior to that of fur which has been allowed to stand for some time. Acidulated water causes an increase in the shrinking power, while fatty substances have a contrary effect. The season of the year in which the animal is killed is also an important factor. The initial preparation of the furs for felting purposes is often a separate industry carried on by the so-called hatters' fur cutters, who deliver the prepared fur to the hat manufacturers, sometimes already mixed and blended, according to the quality of the hat required. The preparatory processes include washing and removing projecting hairs by plucking or shearing. The fur then undergoes a process called "carroting," an artificial method of increasing the felting property by chemical means, nitrate of mercury being utilized to roughen the fiber and raise the points of the scales. In the manufacture of hats a mixture of two parts of carroted to one of uncarroted fur is usually employed. After the carroting and a subsequent drying process the fur is cut from the pelt by machinery, the pelt being at the same time sliced into strips and used in the manufacture of glue and gelatine.

The first step in the hat factory proper is to further cleanse the fur by the removal of all foreign substances, including stray hairs, which the preceding processes have failed to eliminate. To accomplish this the material is passed through two machines, called the devil and the blowing-machine. The former consists of a cone-shaped casing studded interiorly with large teeth and a cone revolving inside of the casing, with teeth moving between the teeth of the latter. The larger end of the inner cone is provided with fan-blades which cause a current of air to pass through the machine, drawing the material with it. The fleeces, which have first been thoroughly stirred up by hand, are separated, fluffed, and the fur mingled and prepared for the blower by this operation. The blowing-machine consists of a number of sections, each of which is provided with a moving apron carrying the fur between two rollers. A picker revolving at a high rate of speed is located beyond the rolls and this tosses and fluffs the fur, the lighter particles falling upon the moving apron of the succeeding section, while the heavier impurities drop through a space between the picker and the apron. After passing through the blowing-machine the fur is ready for the next step, called "forming."

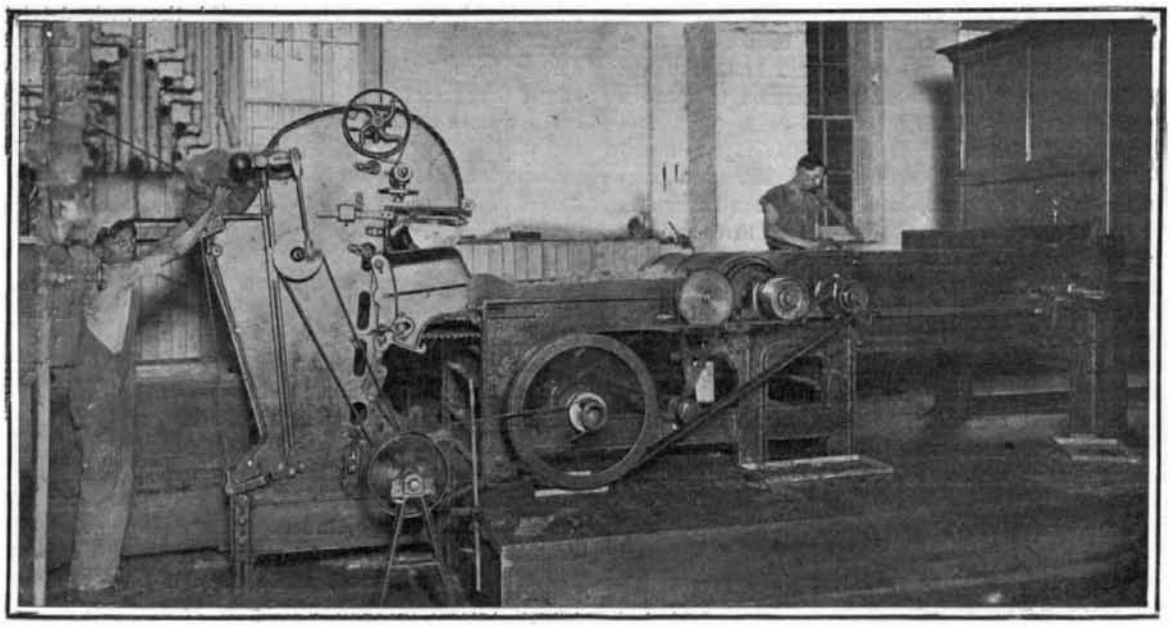
The forming machine consists essentially of a casing inclosing a revolving turntable carrying a perforated copper cone about a yard high. The machine is provided with proper feed apparatus, including an oil-cloth apron, feed-rolls, a picker, and a feed-drum. A powerful exhaust fan creates a strong suction, so that the fur is drawn from the drum and quickly and evenly covers the cone, through the perforations of which the air passes. The finer, lighter particles collect near the top of the felt body—later the crown of the hat—while the heavier, poorer fibers settle lower. A quantity of fur sufficient for one hat has first been weighed out, and when this is all on the cone the latter is covered with wet cloths and immersed in hot water for about one minute. The body is then stripped from the cone and undergoes the next or hardening process. In this, a workman first examines the body for imperfections to be removed or for weak places to be strengthened by the addition of a small quantity of fur, and then wraps about a dozen of the bodies in a woolen cloth, and rolling them by hand, gives them the initial hardening. This gives the body sufficient strength to allow handling with safety.

The succeeding step is called "first-sizing," and is the beginning of the felting proper. During this process the long, loose, cone-shaped body shrinks to a compact, closely-felted fabric of about one-third its original dimensions. During first-sizing the bodies are carefully and repeatedly inspected for imperfections or impurities, and the creases smoothed out. Sizing is simply a system of machine and hand rolling of the bodies, alternating with immersions in hot water. Naturally the rolling must at first be gentle, but as the fabric becomes stronger the work may be done more rapidly and with greater pressure. The bodies are usually first-sized three at a time, wrapped in bur-



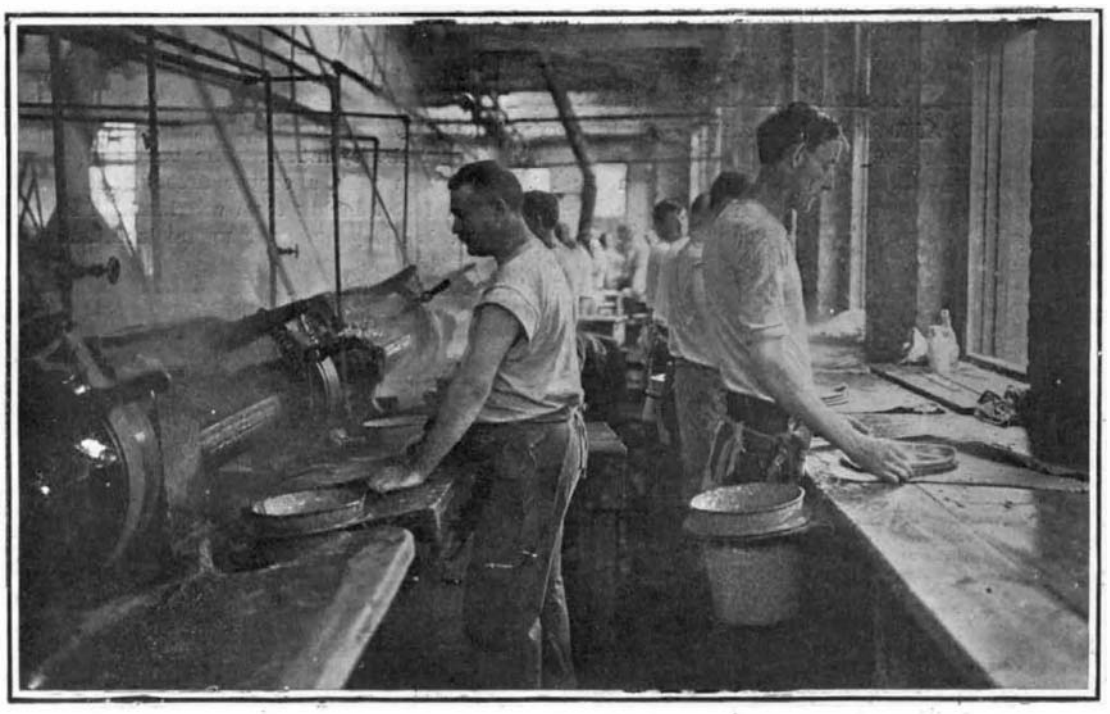
The New Clam-Shell Dredger Open.

The Dredger Closed.

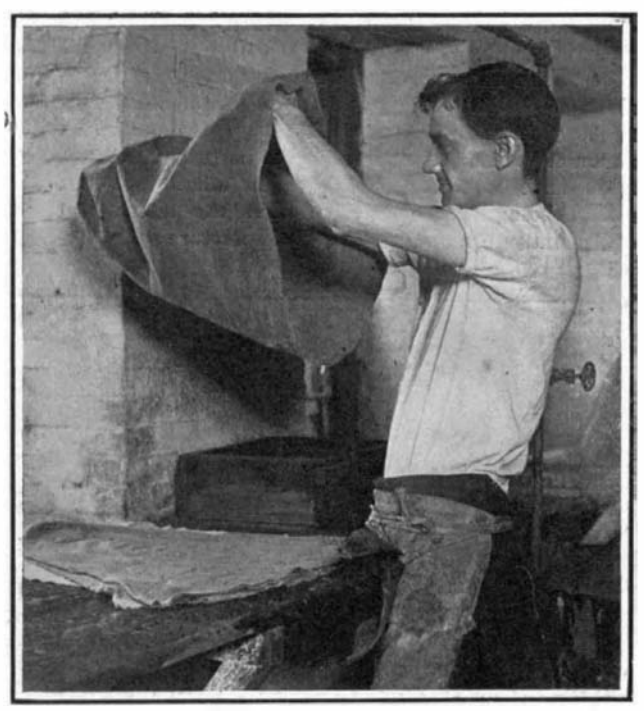


The Blower, by Which the Fur is Prepared and Cleaned for the Forming Machine.

Stripping Body from the Cone After Forming.

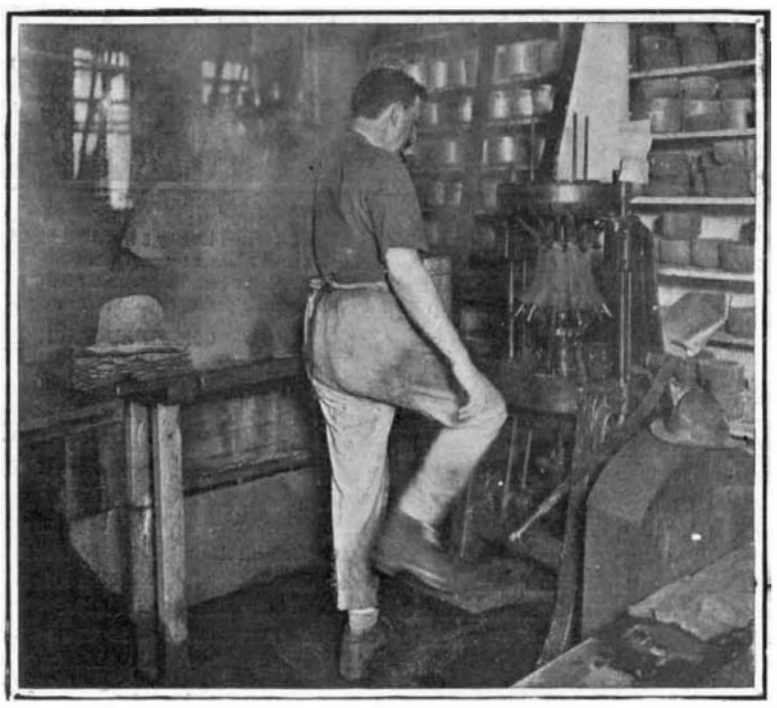


First-sizing. In This Operation the Felted Body Receives Its First Shrinking.



Looking for Imperfections in the Body Prior to Hardening.

Second-Sizing. Using a Rolling-Pin to Shrink the Body Further.



Stretching the Crown and Brim—One of the Shaping Processes.

Finishing the Crown in the Hydraulic Press Which Gives It the Final Shape.

Crown-Finishing. Polishing the Hat After It is Pounced with Fine Sandpaper.

Curling the Brim to Give It the Proper Shape.

THE MAKING OF A FELT HAT.

lap. The machines used are comparatively simple and consist substantially of a pair of rolls of more or less irregular surface. During the sizing operation the fibers are bent by the rolling and spring back when the pressure is relaxed, thus creeping root foremost and entwining around each other in inextricable confusion, and compacting the entire mass into the close felt fabric.

The next operation is shaving the bodies to remove the protruding hairs which, notwithstanding the previous cleansing processes, sometimes remain in the fur. This was formerly done by hand, but to-day a machine in which a knife, moving back and forth with great rapidity, is passed over the surface of the body, is usually employed. After the shaving the body is ready for the so-called second-sizing, which still more compacts the felt, as the shaving has left it more open and porous and consequently prepared for further shrinkage. The second-sizing and pinning-out is done by hand at so-called batteries, but instead of doing three at a time wrapped in cloth, only one body is manipulated, being rolled on a board with an instrument not unlike an ordinary rolling-pin. The battery is a large tub surrounded octagonally by planks sloping slightly inward, and filled with water kept hot by condensed steam. Eight men usually work at one battery.

When the moisture has been thoroughly removed from the felt at the completion of the second-sizing the body is ready for the stiffening. The stiffening substance is shellac conveyed to the body by a solvent, which may be either alcohol or an alkali, the first method being more expensive than the latter, and consequently confined to the manufacture of high-priced hats. The body is repeatedly dipped in the solution and passed between rollers to force the stiffening substance into the fibers, and when the body is sufficiently impregnated the solvent is either evaporated or neutralized by a dilute acid. When the bodies are thoroughly dried they are placed in a metal chest and live steam is admitted. This liquefies the shellac which, by capillary attraction, is partially drawn from the surface into the interior of the fabric. After that operation the stiffener is entirely cleared from the surface by quickly dipping the body into a hot alkaline solution and then allowing it to remain for a period in tepid water. Great care must be exercised during the stiffening, as poor workmanship or inferior materials may cause the manufacturer great loss.

After the stiffening process is completed the hats undergo various shaping and stretching operations in machines which give them their initial forming and prepare them for the hand-blocking. The latter operation is performed at batteries similar to those in use during the sizings, and consists in immersing the hat in boiling water and shaping it by hand over a wooden or metal block of suitable form. This, of course, affects only the crown. The hats are now dyed in the usual manner common to many industries. While vegetable coloring matter was formerly used exclusively, the introduction of the aniline dyes was eagerly welcomed by the hat manufacturer, who at once recognized their value, and to-day they are used to the exclusion of all others. After the hat is dyed it is again hand-blocked, and then it is allowed to dry out thoroughly before undergoing the next or finishing operation.

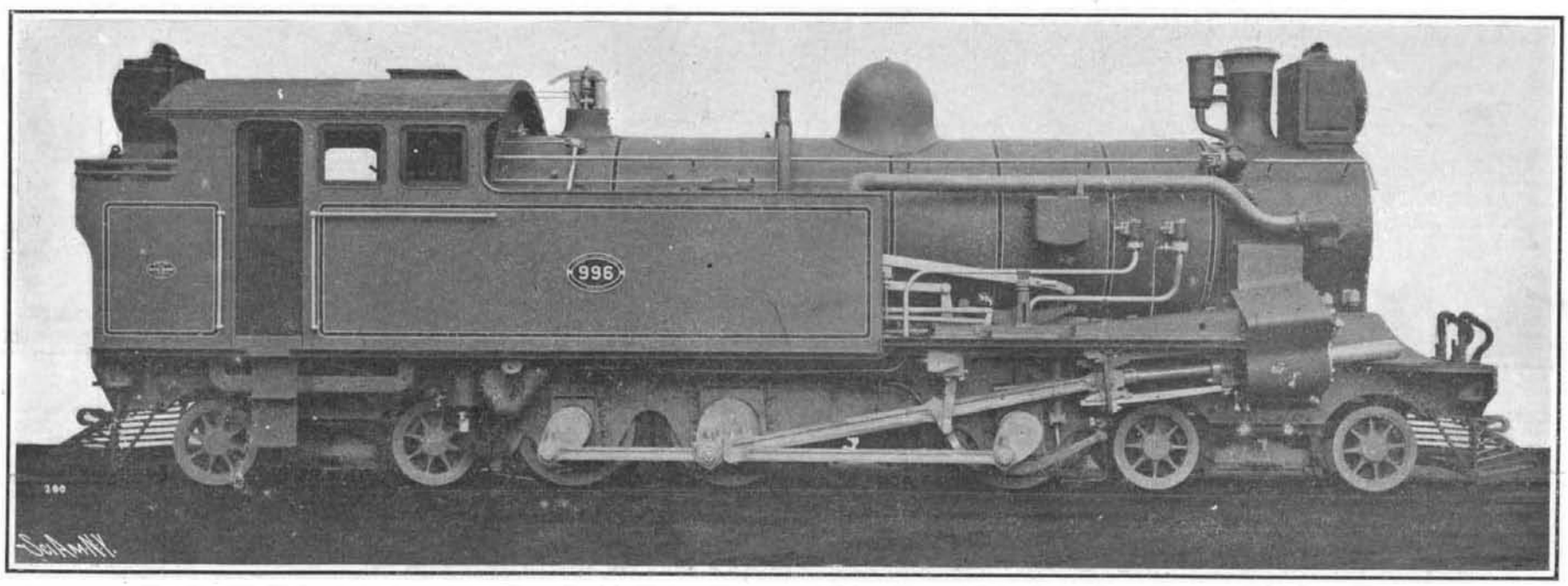
To finish the hat, it is placed in an iron case and steamed to make it soft and pliable and is then placed in an hydraulic press to give the crown its final shape. After this the condensed steam is thoroughly dried out in gas ovens, the hat is pressed to remove all inequalities, and finally pounced with very fine sand-paper. The brim is now cut to the right dimensions and then, softened by means of hot sand bags and a heated metal bench, is curled by hand irons to the proper shape. Most of the operations in the finishing process are performed by hand, but here, too, machine work is being introduced, and before long the manual operations will probably be in the minority. At present, machines are partially used for the ironing of brims and crowns and for the cutting and curling of the former. The final trimming is done by girls and is a manual operation. This consists of sewing on the bindings, bands and leathers and fastening in the linings, after which the hat is ready for the market.

With the exception of the amount of shellac used in the stiffening process, the procedure in the manufacture of soft felt hats differs very little from that of the derby. However, before being finished the tourist hats undergo a separate pouncing process, an additional step which is a distinct branch of the business, performed by operators called pouncers. The soft hat finisher does very little pouncing, in fact just enough to surface the felt.

COMBINED RACK AND ADHESION LOCOMOTIVE FOR SOUTH AFRICA.

In the accompanying photograph we illustrate a unique type of powerful locomotive which has quite recently been completed by the Vulcan Foundry, Limited (Newton-le-Willows, England) for the Central South African Railway system, and the first of these engines, the largest and most powerful of their special type ever built, is to be shortly introduced for assisting the heavy corridor express trains over the exceptionally severe gradients which are encountered between Waterval Onder and Waterval Boven on the stretch of railway separating Laurenco-Marques from Pretoria.

It was required of these locomotives that they should be able to assist, with an adhesion engine in front, a train of 350 tons over a 1-in-20 gradient for a distance of about 3½ miles, and that they should condense their own exhaust steam while passing through a tunnel situated at the top of the incline. It will thus be seen that not only was high tractive force and efficient steaming capacity called for, but also effective brake power, and in the engine illustrated herewith these requirements would appear to have been very completely met. The engines, it may be pointed out, have two entirely distinct pairs of cylinders, 18 inches in diameter by 20 inches stroke, the inner pair driving a coupled pair of cog wheels, carried upon a frame suspended from the leading and driving coupled axles. The connecting rods of the inside engine are connected to projections of the coupling rods of the rack gear and not directly to the crank pins—a method which has been rendered necessary by the restricted width available between the tires. The rack axle bearings are adjustable vertically so as to compensate for the wear of the adhesion wheel tires, and for this reason also the teeth are of involute form, so as to insure correct action between the adjustments. The cranks are of the disk type, having triangular circumferential grooves in which the cast-iron blocks of a hand-power band brake work. The teeth of the rack driving wheels are cut from steel rings and driven through spring keys from the axles so as to compensate for slight irregularities in the pitch of the rack. The main frames of the engine are outside the wheels and are of cast-steel plate, 1¼ inches in thickness. The six-coupled wheels driven by the outside cylinders are 3 feet 6 inches in diameter and carry a load of 45 tons, while the bogie wheels have a diameter of 2 feet 6 inches. The valve motion is Joy's and that of each engine is separately reversed by its own screw gear. There are no fewer than five distinct brakes: (1) Steam brake on all coupled wheels and on both bogies; (2) hand brake on coupled wheels; (3) hand-worked band brake on crank disks of rack engine; (4) Le Chatelier counter-pressure brake on pistons of rack engines, and (5) the counter-pressure air brake on the pistons of the rack engine. This last-named brake consists of a valve in the base of the blast pipe which isolates the cylinders from the smokebox and prevents the entrance of hot gases and cinders when the motion is reversed, while there is a pair of non-return valves, through which air is drawn from outside the smokebox into the exhaust ports and thence compressed into the steam pipe. A graduating discharge valve is fitted and through this the compressed air is allowed to escape into the atmosphere through a silencer carried on the chimney, while a small water jet delivers a cold spray into the exhaust space, which serves to take up the heat of compression and prevent overheating of the cylinders. The boiler is built of mild steel plates with a copper firebox, and has its center line 7 feet 6 inches from rail level. The working pressure is 200 pounds per square inch, and there is an abnormally large water capacity in order to assist the supply of steam through the short tunnel, previously referred to, in traveling through which the blast pipes will not be working. There are 197 charcoal and iron tubes, 2 inches diameter and 12 feet 7 inches in length, while the heating surface amounts to 1,438.33 square feet, to which the tubes contribute 1,298.13 square feet and the firebox the remaining 140.2 square feet. The grate area is 33½ square feet and the combined capacity of the side and bunker tanks is 1,200 gallons of water, while there is space provided for 50 hundredweight of coal. In addition to the engine brakes, the locomotives are fitted with a combination ejector and pipes for working the vacuum brakes of the train, when necessary. The engines, when empty, weigh 70½ tons, and, in running order, 84½ tons, and in appearance conform largely with the other powerful types of locomotives built for the Central South African Railways by the Vulcan Foundry, Limited, with as many parts as possible of which the rack and adhesion engines have been designed to interchange.



Cylinders: 2 outside adhesion; 2 inside rack; diameter, 18 inches; stroke, 20 inches; steam ports, 1⅜ inches by 16 inches; exhaust, 2½ inches by 16 inches. **Boiler:** Barrel, 12 feet 2⅝ inches long; diameter outside, 5 feet 1⅜ inch. **Firebox:** Outside shell, 10 feet 3⅛ inches long by 5 feet 4 inches, 4 feet 3 inches wide; inside copper box, 9 feet 4⅛ inches long by 3 feet 9 inches, 3 feet 6⅜ inches wide; height, 4 feet 7¼ inches. **Tubes:** No. 197; diameter, 2 inches; length, 12 feet 7 inches between tube plates. **Heating surface:** Tubes, 1298.13 square feet; firebox, 140.2 square feet; total, 1438.33 square feet. **Area of fire grate,** 33.5 square feet. **Wheels:** Bogie, 2 feet 6 inches; coupled, 3 feet 6¼ inches; rack on pitch circle, 3 feet ⅜ inch. **Water capacity of tanks,** 1,200 gallons. Coal space for 2½ tons. **Working pressure,** 200 pounds per square inch. **Tractive force,** 80 per cent; adhesion engine, 22,085 pounds; rack engine, 25,636 pounds; total, 47,721 pounds.

COMBINED RACK AND ADHESION LOCOMOTIVE FOR SOUTH AFRICA.

Preparation of Caoutchouc in Africa.

The French administration in western Africa has undertaken the improvement of the quality of caoutchouc by initiating the natives in suitable methods. The adulteration of caoutchouc is entirely forbidden. Incisions in the rubber trees and plants are prohibited, except under limitations prescribed, and they are entirely forbidden during those months when the sap is rising. Professional schools are to be established, where the best processes for the harvesting and coagulation of the caoutchouc will be taught.