INDIA-RUBBER FLUTES.

Of all the materials for making flutes, neither ebony, nor cocoa-wood, nor glass, nor silver, nor gold, nor box-wood, nor any other known substance is equal to vulcanized india-rubber. Messrs. A. G. Badger & Co., the American manufacturers of the world-renowned Bœhm flute, after repeated experiments and the test of several years' use, have decided to adopt india-rubber as the principal material in their extensive manufactory. In speaking of it they use the following language:—

"All the tones are produced with the greatest ease throughout the entire register, in perfect tune, and with a tone remarkably sweet, brilliant and powerful. The first attempt to use Goodyear's patent vulcanized india-rubber was made about eight years ago. We then made four experimental flutes for Mr. Goodyear; one, an ordinary eight-keyed flute, and three of Bœhm's invention. One of these latter Mr. Goodyear presented to a resident professor of Brooklyn, N. Y., who still uses it, and the remainder were exhibited at the World's Fair, in London, and at the Paris Exposition, receiving premiums in both cases. But at that time, owing to the uncertainty of making the india-rubber of sufficient beauty and solidity, we declined adopting it as a leading material; but within the last few years so great improvements have been made that it is rendered beautifully black, it receives a polish as elegant as that of the finest enamel, will not split or break, is in every way entirely impervious to moisture, and is unaffected by all changes of heat or cold. We have, at great cost, procured from the patentee of Goodyear's hard rubber, the exclusive right to use this material in the construction of the Bœhm flute. We have done this after a series of experiments made by various first-class professors and amateurs of the flute, for the purpose of testing its tone-producing qualities, which experiments have resulted in a conviction of its superiority over the cocoa-wood, in making the straight-bore Bœhm flute. In nine cases out of ten, the cocoa-wood Bœhm flute will split; and when there is so much labor expended as there must be in the Bœhm flute, it is of the greatest importance that it should be made of a material not liable to such a contingency."

The Bœhm flute was invented in Europe in 1832, and is said to have there almost entirely superseded the ordinary flute. Its essential peculiarity is the use of keys for stopping all the holes. We give an illustration of one of these famous instruments made of india-rubber by A. G. Badger & Co., No. 181 Broadway, New York, who will be pleased to answer all enquiries which may be addressed to them in relation to it, and who can furnish instruments at all prices up to $500.

THE MANUFACTURE OF AXES.

[Concluded from page 267.]

THE CUTTING-UP.

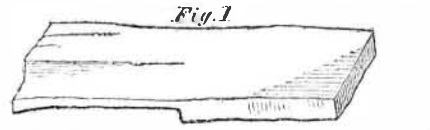
As often as the operation is needed, the workmen are accustomed to devote one or more days to the "cutting-up" of a quantity of "stock" into "patterns," a pattern being the proper portion of iron or steel for one ax. In making the steel patterns, the ends of a number of bars are kept "heating" by the helper, care being taken not to burn the steel by overheating it. The foreman pulls out a bar, and, after the helper has slightly curved the heated end with a stroke of the sledge, places the heated end on the "hardy," which is gaged to the length of a pattern, and holds a cold chisel upon it, directly over the cutting-edge below, the helper striking it off with two or three smart blows. This cutting is sometimes done by machinery. The foreman then seizes the red-hot bit of steel in a pair of short-lipped tongs, prepared for the purpose, and, either with the aid of peculiar swedges at the trip-hammer or by means of a tool called a "set," which is struck by the helper, "chamfers" or "scarfs down"—or, in untechnical language, sharpens down—the side which has been curved inward, to a blunt edge; and a few blows on the ends and faces, to make it shapely, finish the steel pattern. It is then thrown upon the heap, ready to be used when wanted.

The bars of iron are marked off into oblong sections, about $8\frac{1}{4}$ inches in length. They are cut a little at the division lines with a cold chisel, generally on both sides of the bar, and are broken off, one by one, by a few sturdy blows of the sledge. The iron is sometimes cut up, as a lady would clip off the ends of a piece of tape, by means of a pair of terrible shears worked by machinery, one blow sufficing for each. The patterns are then piled away for future use. They will weigh from four to five pounds, according to the intended weight of the finished ax. A "single portion" of steel, which is the common allowance for one ax, weighs about a pound; "double portions," which are generally preferred by good choppers, because they believe that the extra amount of steel surface makes an ax "slip into the wood" easier, weigh from one and a half to two pounds —usually the latter. Great choppers, however, sometimes order enormous axes, weighing not unfrequently ten pounds (five being the average!), and containing three pounds of steel. They tell amazing stories of the achievements of great choppers, who pretend to "chop, split and cord" from four to six cords of hard wood in a day!

THE PLATING-OUT.

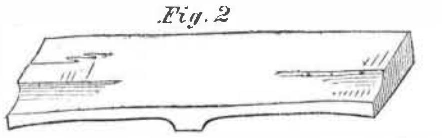
The foreman takes as many "ax-patterns" as he intends to work up, and marks a space about an inch wide across the center of each, which portion of the pattern is afterwards to be the "head" of the ax. Then two or three are thrust into the cast-iron cavern, from which the flames are bursting with all imaginable fury; and when one is sufficiently heated (which means almost melting), it is taken by the foreman to the trip-hammer, and shortly comes back in a shape resembling this figure:

Fig. 1



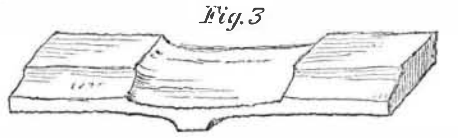
After another "heat" and another excursion, it has assumed this shape:

Fig. 2



With a little hammering, by the foreman and helper, at the anvil, the pattern is "plated out,"

Fig. 3



and is then ready for

THE WELDING-UP.

The pattern is heated and "doubled-over" by hand, in which stage it represents this figure. Gleams of intelligence now begin to appear in the face of the reader. He now sees that the two ends of the pattern are to be welded together, and will form the solid part of the ax between the eye and the steel bit. Before these ends are brought quite together, a bit of iron is thrust between, to be welded into the mass, and make the ax "full under the eye," an effect which could not be produced with iron of the thickness before-mentioned, unless this piece of iron were added. It is called the "throat-piece," "slug," or "Dutchman." The ax now begins to be called a "poll," which term ever after clings to the iron part of it. Sometimes many of the patterns are brought to the shape above described before any are "welded up;" and, indeed, it is usually the system to bring many at once, of the embryo axes, through each successive stage of the manufacture. In "welding up the poll," the iron mass, after being plentifully strewn with borax, is first brought to "welding-heat," in which state the metal is white and ready to melt; and then taken to a trip-hammer, which has been fitted with another set of swedges, and soon (after having been also hammered a little by hand) exhibits a shape like Fig. 5.

Fig. 4

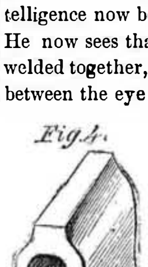
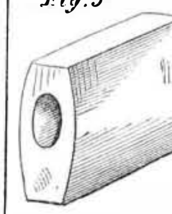


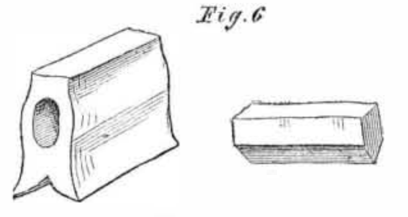
Fig. 5



PUTTING IN THE STEEL.

The end of the poll opposite the head is then heated (or "he't," as the workmen say), and split down through the center with a cold chisel to the depth of three-quarters of an inch or more. The two "lips" of the divided iron are then "chamfered down," or brought to a blunt edge, with a "set," and the poll is ready for the steel.

Fig. 6



The steel is fastened lightly in its place by hammering down the "lips" upon it; a spoonful of borax is poured along the "seam," and the whole is once more thrust into the fire. Much care must now be exercised by the helper, that he may "get a good heat" without "burning" the steel. Careless workmen spoil many axes in this stage of the manufacture, either by burning the steel or heating so badly that a perfect union of the iron and steel cannot be effected. At the proper moment, found only after repeated examinations, which get more and more frequent as the heating progresses, the foreman (who, for the last few moments, has himself attended to the heating) again hurries to the trip-hammer with the glowing mass, which is soon, with still another set of swedges, all welded thoroughly, iron to steel, and comes back a rough semblance of an ax.

Two or three more heats are taken. The helper "draws down the bit" to something like an edge, with rapid, light blows of the sledge, assisted by the foreman, who holds the ax upon the anvil, and constantly guides the blows of his fellow by blows of his own; the head is "hammered off" with frequent use of the "eye-pin" or "wedge;" the bit is once more re-touched by the foreman, who gives the ax a general inspection and "stright-ens" it, and then it is ready for the temperer.

JUMPING AND UPSETTING.

Choppers, farmers, and others who use axes a good deal, if they live in the neighborhood of a factory, are in the habit of saving the expense of a new ax by taking the "poll" of the old one, of which the steel is used up, to be "jumped" or "upset." The first of these operations consists of heating an old poll as though it were a new one, and putting a new steel into it in the way described for new axes. "Upsetting" consists of re-heating a half-worn ax, and "drawing down" the steel, or otherwise making it available for renewed use.

TEMPERING.

Experience and great care are indispensable in "tempering." If the temper is left too "high" or too "low," if the steel is overheated ("overhe't"), or plunged into the "pickle" at the wrong time, the ax is ruined. The process is briefly this: The steel and whole bit of the ax are brought to a red-heat, and plunged into cold water, or a composition or pickle, various recipes for which are cherished as valuable secrets. This leaves the temper extremely high; and steel, in this state, is frequently hard enough to scratch glass, and almost as brittle as that material. It is necessary to "draw" the temper thus obtained, that the cutting-edge may have the toughness requisite to enable it to "stand" the strain to which it is subjected in chopping. The steel is therefore held over a dull fire of coals, the varying degrees of hardness being indicated by the changes in the colors which spring to the surface of it. These changes are very curious, and, if suffered to exhaust themselves, seem to follow the order of the colors in the solar spectrum, though commencing at neither extreme. First is observed a light straw-color; next, gradually deeper shades of that color; then pink, or a reddish-yellow tint, is observed, which deepens, and at last becomes violet. Blue follows, and indicates the lowest degree of hardness—next above no temper at all. The temper for axes is arrested in the deeper shades of reddish-yellow (sometimes not till blue appears), by plunging once more into cold water.

GRINDING, STAMPING AND FINISHING.

From the tempering-room, the axes are taken to the "grinding-room." The grindstones used for axes, when new, are from four to eight feet in diameter, and from six to twelve inches in thickness, weighing from 2,000 to 4,000 pounds. They are made to revolve with great velocity, and sometimes burst with the violent motion, endangering the lives of the workmen and all who happen to be in the neighborhood. The "grinder" seats himself on a "horse" or lever, the rear end of which is fastened, so as to allow of a free movement of the other end. Between the forward end of the lever and the stone, he holds the ax (in front of him as he sits), by means of a stick passed through the "eye," and grasped in both hands. He is thus enabled to exert great pressure on the ax, the rough portions of which are rapidly worn away by the revolving stone; while the position of the point of contact is constantly shifted by a skillful combination of three "motions." The shape of the ax, the slope of the sides, the angle of the cutting-edge, &c., &c., are all determined by the eye of the workman, who learns, by long practice, to be independent of any pattern or formal direction. Sometimes the axes are partially ground, or "rough ground," before being tempered—a plan which, as the steel part is then much softer than afterwards, saves time and labor if it happens tht the stone is not "sharp-gritted," and does not "take hold" well.

The axes are now "stamped" with the maker's name and address, by means of one or more hardened steel "stamps," which are small oblong tools, upon one end of which are raised letters reversed, a smart blow from a sledge being sufficient to imprint them on even cold iron.

After stamping, which operation is performed by two men, the axes go to the "finisher" or "polisher," who, with a number of "emery-wheels," from 18 to 24 inches in diameter, coated with emery of various degrees of fineness, and which revolve with extreme rapidity, gives the bit of the ax (and sometimes the head, also) a high polish. The wheels are made of wood, coated with leather, and the emery is fastened to the surface with glue. The best polishing requires at least three, and generally four, wheels. When the head of the ax is not polished, it is "painted" with a composition formed by boiling asphaltum or other pigment in turpentine, and which dries rapidly. To do this neatly requires considerable dexterity.

After the axes have undergone an inspection, they are placed in boxes containing one dozen, and are then ready for shipment.

PUMPING-ENGINES.

There are various cities in this country supplied with water pumped from lower to higher elevations, and from thence distributed by gravitation. This is the best, in fact, the only sensible practical mode of supplying some cities with water. The engines employed for pumping are of large dimensions, and the Cornish single-acting is held to be the best, and has been generally adopted. While we have imported the Cornish engine as the best known for pumping purposes on a large scale, efforts have been made in England to supersede it, and other engines, of a totally different character, have been lately tried. At a meeting of the British Institution of Mechanical Engineers, London, a paper (since published in Newton's *Journal of Arts*) has been read, on a new pumping-engine erected near Newcastle-on-Tyne, for supplying that and other places with water, the substance of which paper we here give as a matter of much interest on account of the new and useful information it contains.

The paper referred to was read by Mr. Robert Morrison, the builder of the engine. The water-works are situated about two miles west of Newcastle-on-Tyne, where extensive filter-beds and a very large basin for pure water have been recently constructed. About ten miles distant from this there are eight very large collecting reservoirs, containing at ordinary level 600,000,000 gallons of water. The average low water level of these reservoirs is 360 feet above the high water-line in the Tyne, and the water is conducted into the towns of Newcastle and Gateshead through a 24-inch cast-iron main, by gravitation. Owing to the extension of these towns up the bank of the Tyne, considerable portions of them are above the level to which the water will flow direct. To supply these districts, an engine and reservoir were constructed some years ago, which afterwards proved insufficient, through the increased demand for water. The engine now erected can, at all times, supply the highest districts by gravitation alone, with an unlimited supply of water.

Down the bank, at about the level of high water in the Tyne, runs the 24-inch Welton main, from which a 10-inch branch has been led up the hill-side a distance of 2,240 feet to the filter-beds already mentioned, which are placed at a level of 246 feet above the high water line in the Tyne. The water passing from the beds to the pure water basin, is conducted to the engine suction-pipe, and is driven through another 10-inch main, 3,850 feet long, into a second recently-formed reservoir at the top of the bank at High Benwell, 412 feet above high water in the Tyne, from which the town is supplied through a 10-inch main. When it is not required to pass the water through the filtering-beds or pure water-basin, the 10-inch branch from the Welton main delivers the water direct into a well 20 feet deep, whence it is pumped by the engine, as before, to the second reservoir up the hill. The hight from the bottom of the well to the end of the delivery pipe reservoir is 182 feet, which is the hight the engine has been lifting during the experiments; for the depth of water in the well has generally been about equal to the depth of water in the high reservoir.

The pumping engine, which was erected twelve months ago, is a horizontal high-pressure expansive and non-condensing engine, working direct a double-acting pump, and coupled to a crank and fly-wheel.

The steam cylinder is 26 inches diameter and four stroke; and the pump, which is worked from the same piston-rod, is 11½ inches diameter. A cross-head is keyed upon the piston-rod, and guided by a cylindrical slide on each side, working on round guide-rods, carried by brackets from the bed-plate. The connecting-rod is coupled to the cross-head, close to the piston-rod, which is lengthened sufficiently to allow the crank to clear the end of the pump. The cross-head is made solid, in one piece, with the cylindrical guide on the side to which the connecting-rod is attached, and the other side is made with a socket and keyed. The fly-wheel is 16 feet diameter and 5½ tuns weight. The pump is double-acting, and has a solid piston, fitted with cupped leathers facing both ways, with a brass piece between them, to preserve the leathers from being cut. The pump valves are rectangular butterfly valves, of india-rubber, 1½ inch thick, beating on ½-inch bars, with 1-inch spaces; the total area of opening in each valve seat is 112 square inches. The suction valves open from a chamber in the bed-plate to which the suction pipe leads from the well; and a back flap-valve of india-rubber is fixed at the extremity of the suction pipe, at the bottom of the well, 20 feet below the pump suction valves. The delivery valves are exactly similar to the suction valves and immediately over them, and they are connected by a horizontal pipe parallel to the pump, from which the delivery pipe leads off, proceeding direct to the main. A branch is carried off obliquely from the main to the air vessel, which is situated outside the building, and is 3 feet diameter and 12 feet high. Two small air vessels are also fixed on the top of the pump, immediately over the two delivery valves.

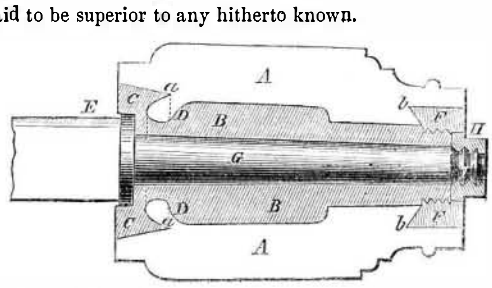
The steam cylinder is fitted with a separated expansion slide, working on the back of the ordinary slide valve. Both slides are worked by fixed eccentrics, but the expansion is made variable by means of a slotted link, vibrating on a center fixed to the bed-plate, and permanently connected to the rod of the expansion slide, which is attached to the center of the link; the eccentric rod being connected to a sliding block, worked up and down the slot by means of a screw, which can be readily adjusted whilst the engine is at work. There is an index on the side of the link to show the degree of cut-off. The exhaust steam is discharged into a cistern cast in the foundation plate, into which the cold feed-water is injected through a perforated pipe; by this means the feed-water is heated and then pumped from the cistern into the boiler. A glass gage on the side of the cistern indicates the level of the water, as it is desirable that there should not be more than three inches depth in the cistern.

As the eccentrics are fixtures on the fly-wheel shaft, and the rods permanently connected to the slide valves, for the sake of simplicity and durability of construction, a special arrangement is provided for starting the engine, by means of a two-way cock, attached to the bottom of the steam chest and connected by small branch pipes to both steam ports, by which the steam can be turned into either port beyond the valve, and the engine readily started. There are three Cornish boilers with single flues, having the fire in the flue; the boilers are twenty-eight feet long and four feet nine inches diameter, and the flues three feet diameter; but only two boilers at a time are used for working the engine. The fire-doors are arranged to admit any quantity of air, and regulated in such a manner as to be under the control of the engineer; the result is perfect combustion and the entire absence of smoke.

The steam is maintained at 60 lbs. per square inch above the atmosphere, and the engine is usually worked with the steam cut off at one-fifth of the stroke. The main slide valve, having always exactly the same motion, whatever be the degree of expansion, the opening of the exhaust and the amount of compression are constant. The usual speed of the engine is 24 revolutions per minute, or 192 feet per minute speed of piston; but has been worked up to 40 revolutions, or 320 feet per minute of the piston. The pressure of water upon the pumps, as indicated by a pressure gage, is 80 lbs. per square inch when standing, and rises to a mean of about 95 lbs. per square inch whilst working, equivalent to 18.6 lbs. per square inch effective pressure on the steam piston, or 57 horse-power effective. Taking the coals consumed for three months, the consumption is 30 cwt. per day of twelve hours, including lighting fires, &c., or 5 lbs. of coal per effective horse-power per hour, and 4 lbs. per indicated horse-power per hour. The consumption of coals is not much more than if this engine had been a condensing one; whilst the first cost of the engine and building is much less.

IMPROVEMENT IN CARRIAGE HUBS.

After all the hundreds of contrivances for hubs of carriage wheels, we have here a combination invented by Jesse Pruett, of Aurora, Kane county, Ill., which is said to be superior to any hitherto known.



A vertical, longitudinal section is represented; A being the usual wooden hub, and B, a metallic box in which the axle, G, turns. The box, B, has upon its butt end an annular enlargement, C, which is made slightly tapering so as to fit tightly when driven into the hub. D, D, are feathers cast upon the block to prevent it from turning. The hub being bored as usual and recesses cut for the feathers, the bore is enlarged at the big end to two-thirds the size of the large end of the box, and to the depth of the flange. The box is then driven into the hub, and the feathers, having sharp ends, cut and curl the wood, causing it to fill completely the recess, *a*, between the feathers and the flange, C. The nut, F, which is provided with the flange, *b*, is then screwed upon the small end of the hub flush with its end, thus securing the box rigidly in its place. When the axle, G, is passed into the hub, it is secured by the nut, H, as usual; the annular collar, I, keeping out the dirt and dust.

The advantages claimed for this arrangement are more perfect and solid union between the box and the hub, resulting from the conical shape of the enlargement, C, and the mode in which the recess, *a a*, is filled with the curled wood; also the great facility with which the box may be tightened, in the event of its becoming loose, by simply turning the nut, F, without even taking off the wheel.

For further information the inventor may be addressed as above.