contrast to the ground wood, is much better suited for furniture and interior finishing. The best specimens of this oak are shipped from the port of Riga, and fetch the highest prices.

A vast quantity of oak is annually shipped from Quebec; this is a coarse reedy oak not so good for ship-building as English, and not so good for furniture as Dantzig or Riga. When not twisted in the growth it may be split evenly into thin pieces, and a large quantity is imported thus split for the use of coopers. It is also used for numerous other purposes, and occasionally in cheap furniture. The "champ" in oak is the principal feature of beauty which commends it in furniture. In the oak tree there are thin veins called medullary rays, that run from the pith to the bark, something like the spokes in a bicycle wheel. In the end of a billet of oak they appear like hard white threads radiating from the centre, and as they run the whole length of the tree, it is by judicious cutting up that their "champs" or rays are best shown. Very much depends on the intelligent cutting up of oak, as well as many other woods.

As these remarks have become somewhat extended we will defer the description of the other woods, which will be less in our work, until we come to notice them in the construction of specific articles.

(To be continued.)

ORNAMENTAL TURNING IN IVORY.

(For Illustration, see Lithograph Supplement.)

THE specimen of ornamental turnery, which we publish herewith, is thus described by the maker in the journal of the Amateur Mechanical Society:

I really hardly know what to call the somewhat nondescript piece of turning represented in the engraving. It is a kind of shallow box, supported on a spiral stem rising from a base which rests upon four feet. The cover of the box has a similar spiral stem rising from it, which ends in a cube with five points, one at each side and one at the top. The whole is of ivory, and measures to the top of the finial about 9in. in height, the diameter of the largest part being about 4¼in.

The base is formed from a flat piece of ivory ⅜ of an inch in thickness, having below four holes into which are screwed the little feet. A disc of ivory of the proper size and thickness having been chucked by its outer edge, the surface was smoothed and polished, and the screw-hole, about 1⅜in. in diameter and $\frac{3}{16}$ of an inch in depth, formed, into which the upper part was to be screwed. The piece was then chucked by that screw upon a wooden chuck, mounted on the eccentric chuck. The under surface of the disc was made true and flat, and the piece shaped by cutting portions from its edge with the eccentric cutting frame carrying a tool of this form (fig. 1.) Fig. 2. shows the shape of the

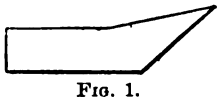


FIG. 1.

base; it is drawn full size. It will be seen that each side is formed by four circular cuts intersecting one another. The slide-rest being placed across the lathe-bed, with the cutter set very accurately to the centre, the slide of the eccentric chuck was thrown out about 2⅜in., and the chuck fixed by the index in such a position that the slide was quite vertical. The eccentric cutter, set to cut a circle of about 2in. in diameter, was brought outwards, that is towards the operator about $1\frac{3}{16}$in. from the centre, and cut No. 1 made, by

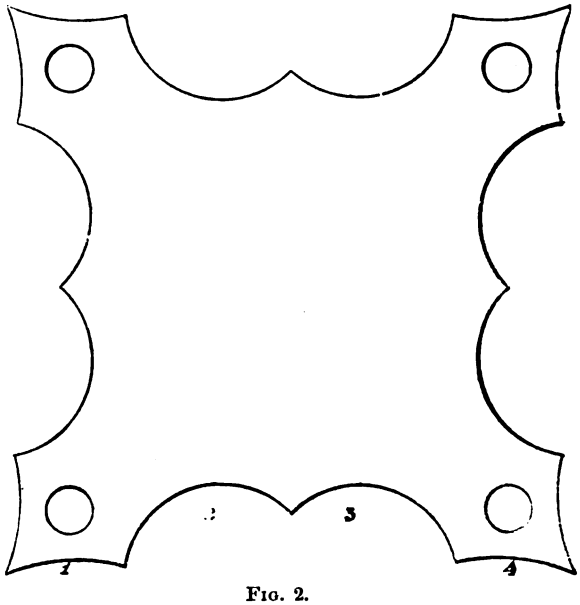


FIG. 2.

gradually and carefully advancing the cutter, until the superfluous piece dropped out. The cutter was then moved the same distance from the centre, viz., $1\frac{3}{16}$in. from the operator, and cut No. 4 was made. The same operations were performed at the other three sides of the base piece, the wheel of the eccentric chuck being moved round 24 teeth for each setting. The slide of the chuck then had its eccentricity diminished to about 1¼in., and the cutter set to cut a circle of 1in., and cuts 2 and 3 were made by placing the cutter at about $\frac{7}{16}$ of an inch at each side of the centre alternately, the same operations being repeated as before for the other sides of the square. In all operations of this kind, when there is a considerable thickness of material to be cut through, it is best to set the cutter for a somewhat smaller circle than the finished one, and make cuts all round in the proper places; then to enlarge the circle a little and go over the cuts again, thus leaving very little for the tool to take off in making the final cuts. Of course it is necessary to make a careful note of the position of each cut, so as to be sure of bringing the tool to the same spot when going round the second time. It is as well, too, in making such a piece as this, to remove a portion of the edge with a fine saw from each of the four sides, so as to reduce the piece roughly to the form of a square, thus leaving less material for the cutter to work through. Of course care must be taken not to encroach upon what is to remain.

The piece being shaped, pencil lines, drawn diagonally, indicated the direction in which the holes for the feet were to be made. The slide of the eccentric chuck was thrown out about 1⅜in., and the eccentric chuck wheel adjusted, so that the position of one of the holes was brought exactly into the centre of rotation of the mandrel. A hole of about $\frac{3}{16}$ of an inch in depth was made with a flat-ended drill, and afterwards enlarged by setting the lathe in motion, and using a right-side tool in the slide-rest. The same operation being repeated for the other holes, the most difficult job came next—that of cutting a fine screw in each of the holes. This required some care, on account of the great eccentricity of the chuck, and I think could hardly be done without a traversing mandrel. The tool must be held very firmly, and the work allowed to come to it very quietly, or there is sure to be a slip, and a drunken screw made.

The feet were shaped, the lower part with the flying cutter working horizontally, with a cutter of this

FIG. 3.

form (fig. 3), the smaller part above that with a pattern-drill. Each piece in turn, having had its screw fitted to one of the holes in the base-piece, was screwed on the same wooden chuck, and, with one setting of the slide-rest, all were reduced to the same length. The slide-rest being brought parallel with the lathe-bed, each piece in turn had its lower part shaped with the flying cutter, and afterwards the upper part of each was made with the same setting of the drill, so that all were precisely the same in shape and size.

The piece next above the base, and screwing into it, has 24 points, formed by the flying cutter working horizontally with a < shaped tool. In this kind of work it is essential that the portion which rests upon the flat surface below it should be made perfectly flat, and not, as it is very apt to be, unless sufficient care be taken, a little hollowed out beyond the edge as in fig. 4, where the dotted line shows the flat sur-

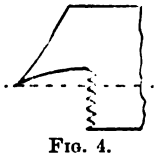


FIG. 4.

face upon which the edge is to rest, and where the hollowing out has been purposely somewhat exaggerated. Unless this is attended to, it is obvious that, when the piece is finished, even supposing the points to remain unbroken, it will rest entirely on the extremities of those points, showing a gap between the base and the portions within those points. Besides this, when the portion between the edge and the screw is not perfectly flat, there is a much greater probability of the points giving way from the action of the tool, and also of the work slipping on the chuck before it is finished. However tightly the piece of ivory may be screwed on to the chuck, when so large a portion of its circumference comes to be removed it is almost sure to slip when only supported by a few slender points as the cuts are nearly finished. For the same reason the surface of the wooden chuck which carries the work while it is being shaped must also be perfectly flat, so as to give support to the whole, and not to the edge only. The upper part of the chuck should be brought to the same diameter as the ivory upon it, and the cuts made through wood and ivory together. The rotation of the cutting tool must be from the outer edge of the ivory towards the centre.

It is not unimportant to consider in which direction the mandrel pulley should move when being shifted from one hole of the division plate to another. As after the first cut has been made the others are formed by one side only of the < shaped cutter, the other side merely passing through the gap already made, it is clear that more pressure is exerted by the cutting side of the tool than by the other. If that pressure is in such a direction that it has a tendency to unscrew the work from its chuck, it may happen, when the pattern is partly finished, that the material is becoming loose on its chuck, and it may perhaps be spoiled before the evil is discovered. The mandrel pulley should therefore be moved in such a direction that the working side of the tool should be on the side which has rather a tendency to screw the work up more tightly; therefore in such a piece as we are now considering, after the first cut has been made, the pulley should be moved with the upper part of its circumference *towards* the operator, instead of from him, for each succeeding cut.

The next piece screws into the one last described. It has round it a ring of beads, while its upper edge is cut out by drawing a pattern drill across it, the slide-rest being placed across the lathe-bed.

Into this piece is screwed the spiral column, formed from a cylinder of ivory $\frac{1}{16}$ of an inch in diameter, and $1\frac{7}{10}$in. long, exclusive of the screw at each end. It was made on the eccentric chuck in the manner described at page 149, vol. II. of this journal, having been previously bored throughout its length by a hole $\frac{7}{128}$ of an inch in diameter, which was afterwards plugged with a polished ivory stem just fitting it.

Upon the upper end of the spiral column is screwed a piece executed with pattern drills, and this screws into one formed on the dome chuck, with flutings cut with the flying cutting frame, carrying such a tool as that used for shaping the feet. In this case the dome chuck was mounted on the oval chuck in order that the curve described by the work in passing in front of the tool should be a portion of a flattened ellipse, and not that of a circle. This piece has a projecting screw at the top, entering into the bottom of the kind of box which forms the principal and widest portion of the work.

This box was made from a solid round block of ivory, about $1\frac{1}{2}$in. in depth, and $4\frac{1}{4}$in. in diameter. Having been hollowed out to a sufficient depth, leaving plenty of substance in the side, so as to form it into a box, the screw-hole by which it is attached to the piece below it was made, and the box was then chucked by that screw, and its outer edge shaped in the following manner:—Figs. 5, 6 and 7

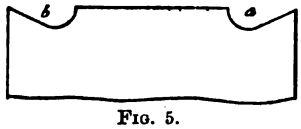


FIG. 5.

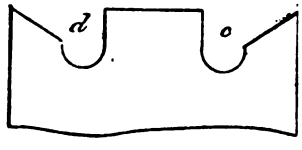


FIG. 6.

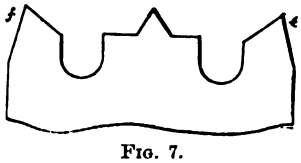


FIG. 7.

show it in different stages of progress. First, two deep grooves were cut in the ivory, leaving the surfaces *a* and *b*, fig. 5. These were then polished. Next, with a pattern drill, two series of holes, 72 in each, were made to a depth of $\frac{1}{128}$ of an inch, as shown at *c* and *d*, fig. 4, every second hole of the 144 division of the division-plate being used. At every third hole of the 72 the drill was carried along by the slide-rest screw until it met the corresponding hole of the other series, thus forming 24 deep furrows, and leaving 24 projecting portions of the original surface between them. The eccentric cutting-frame was now substituted for the drill, carry-

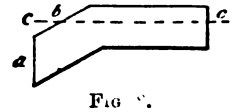


FIG [illegible].

ing a tool which I had to make for myself. It was of the form fig. 8, *a* and *b* being the cutting edges. This tool being so adjusted in the cutting-frame that the dotted line *c* was in the centre of rotation, the instrument being set half-way between the two edges of the ivory, and the index at one of the holes midway between those which had determined the position of two of the furrows, the tool, revolving rapidly, was slowly and carefully advanced, till it had cut away the ivory, leaving one of the little nipples or cones in the middle of a flat facet, as fig. 7, the face *a* of the tool forming the facet, and the sloping face *b* the cone. The slide-rest being placed not quite square across the lathe-bed, but at a slight angle, the 24 scollops, *f* in fig. 7, on one edge of the ivory, were cut by drawing across the face of the work the flying cutter, set to cut vertically and carrying a round-ended tool. The ivory having been previously fitted by its interior to another chuck, was then reversed by being mounted on that chuck, and the corresponding scollops were cut at the other end with the same setting of the slide-rest. Some care was required in this case in adjusting the work so that the scollops should come exactly in line with the facets and cones. This completed the box and stand.

The cover having been fitted so as to lie loosely on the box, was shaped and fluted by the flying cutter, with a tool of the same shape as for the portion below the box, working horizontally, and guided by a template of the proper form in the curvilinear apparatus. The next piece and the upper spiral stem were made in the same manner as the corresponding pieces below the box, but the spiral stem was of smaller dimensions than the other, being made from a cylinder 1¼in. long, exclusive of the screws at each end, and ⅛ of an inch in diameter, bored with a hole ⅜ of an inch in diameter. Upon this is screwed the finial, the lower part having its edge cut with a pattern drill, and above that is a small cube, the sides formed by drawing past each in turn a drill of the form fig. 9. The cones pro-

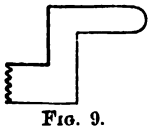


FIG. 9.

jecting from the sides and top of this cube were turned separately and fitted and cemented into holes made for them.

G. C. C.

DETAILS OF LATHES.

By OBERLIN SMITH.

From The American Machinist.

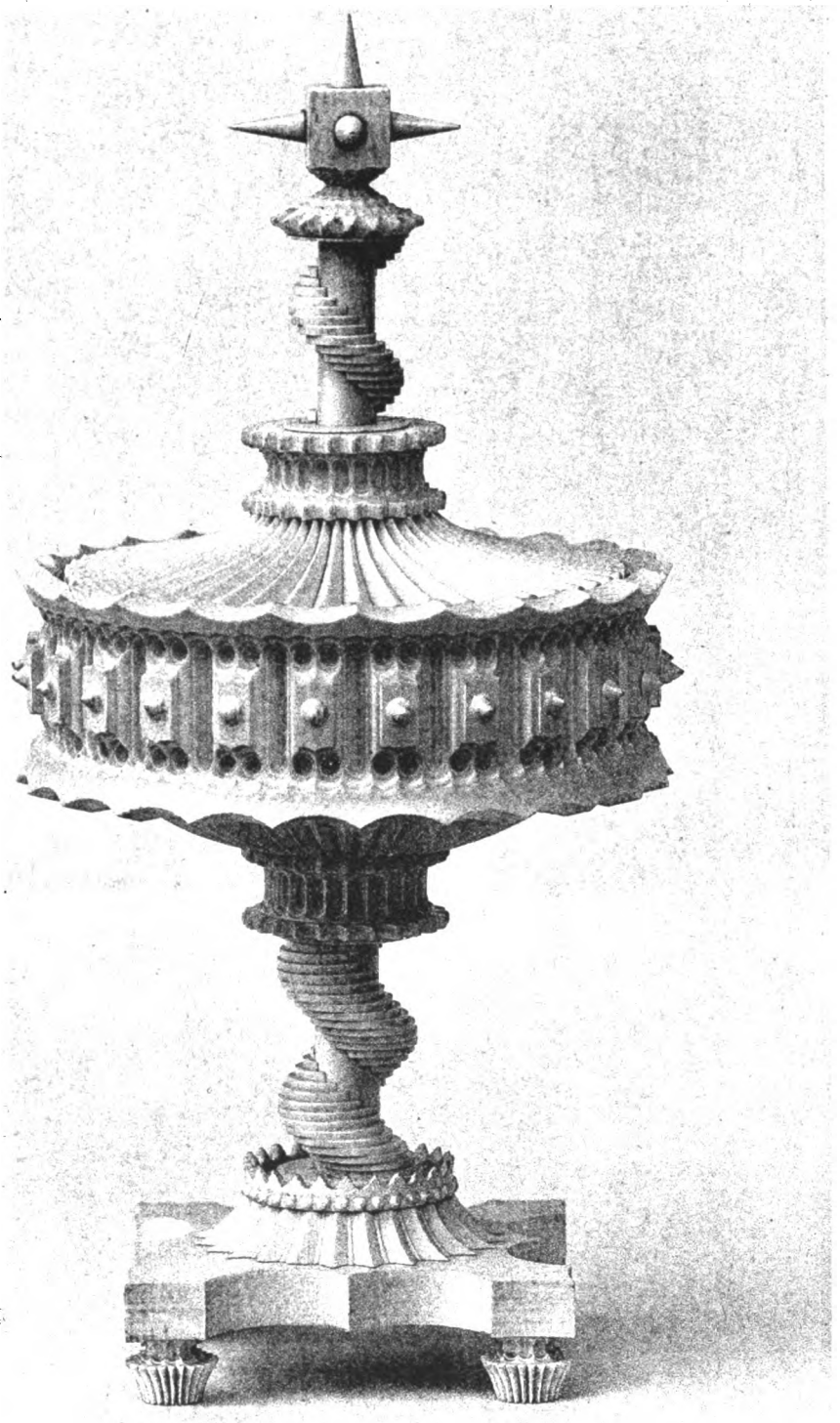
IN a recent article upon lathe spindles, and how the designing of them appeared, in many cases, to have a benumbing effect on otherwise wide-awake intellects, the writer proposed such a radical enlargement of diameters as to introduce certain new difficulties, the method of overcoming which may here be discussed.

In diagonising the case and its symptoms let us assume that we have our old patient, the 20in. swing lathe. Having given it an enormous amount of "backbone" to support, in the shape of a live spindle with its right journal (say) 7in. in diameter and a left one 3½in., we might discover that the smallest pulley of the spindle cone was of but little, if any, greater diameter than the largest journal—that is, if the usual practice in designing cones was followed. Under these circumstances the thing would probably revolve, because the lateral (upward) pressure of the belt would occur at a point near the small journal, and the friction of the oiled metallic surfaces would not be as great as that of leather and iron, but there would not be a great surplus of power left for doing cutting work. The practical minimum size for this pulley in proportion to the journals can best be determined by experiment, as we have no data to consult regarding driven pulleys, which are smaller than their shafts. It is clear, however, that the pulleys must in this case be made larger than they are with the usual small spindles. Probably the lathe in question would work well with the small pulley, 9in. or 10in. in diameter. This, with the larger pulleys of the cone in proportion, the old school designers would object to, because they would have to cut down the sides of the "live-head" low, and thereby lose the important bracing which they now give to the delicate structure that stands up at each end of the head to support the journals. It may be interesting just here to mention that a lathe-maker of excellent repute, dwelling in the immediate vicinity of William Penn's "only headquarters," makes a good, solid looking (by the old ideas) live-head, and takes the trouble to core out the upright parts, nearly up to the bottom of the journals, leaving them mere shells, perhaps ¼in. or ⅜in. thick. Whether the few shillings worth of metal thus thrown out is for the benefit of the worthy guilds of pattern-makers and moulders, by creating a larger demand for their labours, or whether this membranous construction is intended to develop a "*vibratory force*," in opposition to its true and only inventor, is as yet an unsolved conundrum.

The matter of connecting and bracing the upright parts of the head can easily be arranged by throwing further out the side "webs," which connect the two uprights, allowing the cone to be partially down between them. If it is objected that this makes the head (and consequently the bed and carriage) too wide, let it commence to be wider at a point above the carraige, and swell enough to clear the cone—leaving it at the bottom as narrow as usual. This, however, is in case the designer wishes the bed of the ordinary width. A considerable amount of widening is, in the writer's opinion, of no detriment to the machine. In the short, heavy 20in. swing lathes, referred to in a former article, he made the head (which was cast in one piece with the bed) wide enough for the back-gearing to be entirely within it, directly *below* the spindle. This arrangement seems, so far, to work very nicely; it allows the side webs of the head to run up nearly to the centre of the cone. Their outside width is 16in., and the extreme width of the bed 20in. The latter is perfectly flat upon the top, with a large bearing surface for the large and heavy carriage. All this, of course, allows for plenty of the "anvil-principle" in the various parts.

For another reason, besides the presence of a large spindle, should the cone-pulleys of a lathe be made as large in diameter as it is possible to contrive them, namely, to obtain a higher belt speed—a point that is shamefully neglected in almost all machine tools, except planers.

There is but one objection to fast running pulleys of large diameter, and consequently heavy weight upon lathes and other machines which must be started and stopped frequently and suddenly. This is their inertia—using the word in its sense which includes momentum. Even with the small cones generally used, there is time wasted in stopping the lathe when it is running at the fastest speed. The usual remedy adopted by the machinist who feels in a hurry, and doesn't want to "nurse his job," is to use the palm of his hand, as a brake, upon the



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SPECIMEN OF ORNAMENTAL TURNERY IN IVORY.