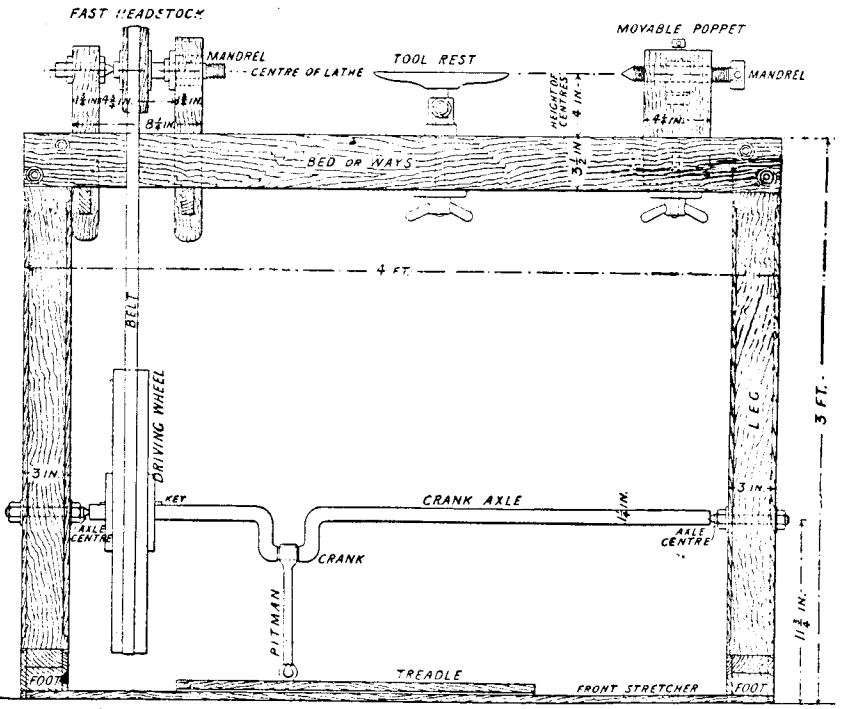
HOW TO BUILD A BOY'S LATHE

A LATHE is a machine in which pieces of wood or metal are turned to circular shapes. Good lathes are expensive if purchased, because they are made wholly of metal, and are produced very accurately. Consequently many lads who would wish to possess one are unable to save enough money to do so. With the exercise of a little skill, some slight help, and a small outlay, many of us will be able to construct a very simple lathe in which most kinds of plain turning can be done just as well as in one built more expensively by an engineer. The lathe is shown in pictures 1, 2, and 3, and its separated parts subsequently. We shall see that it is cheapened and rendered easy of construction by being made mostly of wood.



1. An easily-made foot-lathe for a boy, showing all the different working parts

The very few portions which are of iron may be readily obtained. Anyone attempting to make the lathe should be familiar with the methods of jointing wood explained on pages 1345 and 1346.

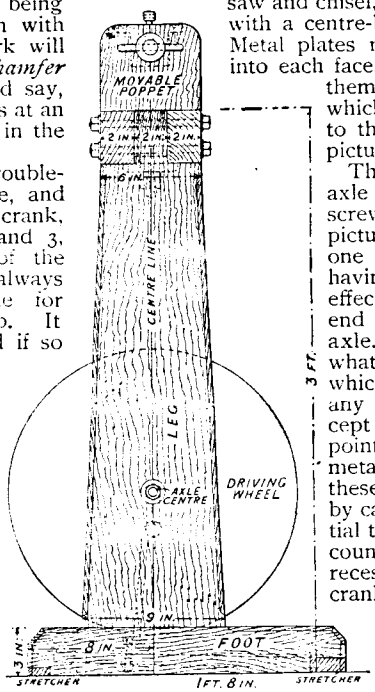
The working parts are placed on supports termed the *bed*, or bed-ways, which are carried on the *legs*, also called uprights, or standards. The bed-ways are made of two strips of deal, or beech, birch, mahogany, or oak, well seasoned and free from knots and flaws. Each measures 4 feet long by 2 inches wide by 3½ inches deep. These must be planed lengthwise truly on each side, and each adjacent side must be quite square with its fellow. If we cannot use the plane well, some carpenter will do this work for us in half an hour. These ways are fastened to the legs, or uprights, each of which is made for simplicity of one solid piece of plank, of any one of the woods just named as being suitable for the bed. Each is cut either from a common deal or hardwood plank measuring 9 inches wide by 3 inches thick in the sawn sizes, and cut off to 3 feet in length. The pieces must be smoothed over with a plane, and the sides cut tapered as seen in picture 2, running from 9 inches wide at the bottom to 6 inches wide at the top.

The dimensions thus far are not very important, but those now to be noted are. The top of each leg has to be shouldered to receive the bed-ways, and the bottom of each has to be tenoned into its foot. These and other dimensions are marked from a *centre line*, and not from an edge. This is important. The bed must be fastened securely to the legs. The best plan is to saw shoulders out of the legs at the [illegible] shown in pictures 2 and 4, and shoulder the [illegible] the bed-strips also. Then two ⅝-inch bolts at each end will be driven through holes bored through bed-strips and uprights.

At the bottom the legs are tenoned into the feet, as seen in picture 5. Two tenons are cut on the lower ends of the legs, and mortises to correspond in the feet. Observe that the mortises are wider than the tenons at the bottom end. This is to permit of the insertion of the wedges shown, to be driven in when the tenons are being glued. Picture 5 shows the appearance of the joint when made thus, before the ends are

trimmed off neatly. A pin or peg is driven in a hole bored through foot and tenons. The legs are maintained rigidly apart at the top by means of the bed. At the bottom two strips of wood form *stretchers*, seen in pictures 1, 2, and 3, and are screwed to the feet at the back and front, being shouldered into the feet flush with the bottom. The timber-work will look all the neater if we *chamfer* the edges, as a carpenter would say, that is, plane off the keen angles at an angle of 45 degrees, as shown in the pictures on these pages.

We now come to a rather troublesome fitting, the crank, treadle, and pulley or driving-wheel. The crank, which is seen in pictures 1 and 3, must be bought. In most of the larger cities and towns we can always pick up a secondhand one for a trifle at a large junk-shop. It may have a pulley on it, and if so that will save trouble. But if not, we can make a pulley of hardwood, the heavier the better. The disadvantage in buying a pulley is that it will have two or three diameters or steps, and probably be grooved for driving rope. A belt is preferable, and a single pulley that is not stepped renders the fitting of the headstock easier. A foot-lathe can be run faster or slower by the working of the treadle without changing the belt from one step to another. If we prefer pulleys with two steps and can make them, the lathe will be rather more handy.

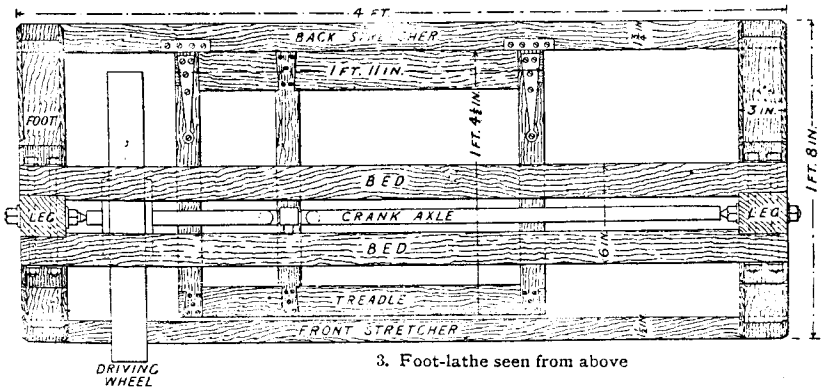


2. Leg of foot-lathe

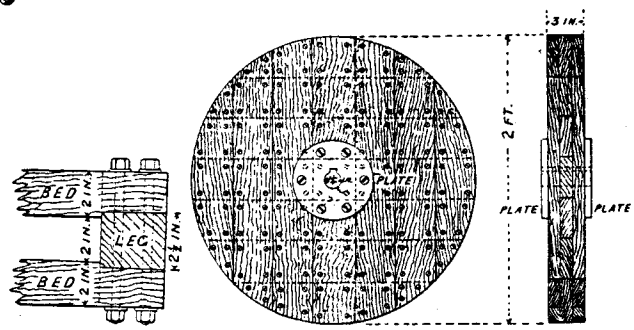
The timber for the pulley should be the heaviest we can obtain, oak for preference, and if we cannot get oak, use birch or beech. Obtain stuff 1 inch thick, cut into narrow strips from 4 inches to 6 inches wide, and screw them crosswise side by side, as may be seen in picture 6. If we make it from one piece of solid wood it will not remain round, and will perhaps split or curve. But built as shown in picture 6 it will remain accurate for an indefinite period. Two thicknesses would be sufficient for the belt, but three are fitted to increase the weight, which is a very desirable thing. After screwing or nailing the strips together, mark a circle with a compass for the outside 2 feet diameter, and another circle for the hole, 1¼ inches diameter. The first must be cut with saw and chisel, and the second bored with a centre-bit to fit the crank-axle. Metal plates must be screwed on or into each face, with key-ways filed in them to receive the key by which the wheel is made fast to the crank-axle, as seen in pictures 1 and 6.

The ends of the crank-axle are recessed to receive screwed *centres*, as seen in pictures 1, 2, and 3, fitting one in each upright, and having a nut at each end for effecting adjustment of the end pressure on the crank-axle. These are made from what are termed *stud-bolts*, which can be obtained at any hardware store, except that the ends must be pointed subsequently. A metal-turner would point these, or it might be done by careful filing. It is essential that these points and the countersunk holes or conical recesses in the ends of the crank-axle should be case-hardened. To do this, get the parts red hot, and rub them in powdered yellow prussiate of potash. Then quench in water. Repeat this three or four times. A better plan is to cover all except the extreme ends in clay, and expose the ends to the heat of a clear fire for an hour or two in contact with powdered prussiate of potash, and then quench in water.

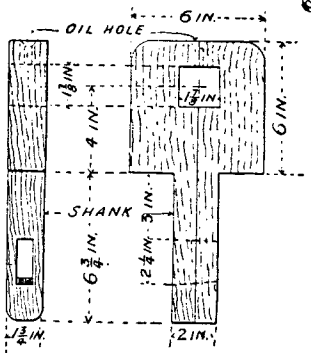
The crank is turned by a *treadle*, and rod, or *pitman*, reaching from crank to treadle. The latter is made of wood, framed as in picture 3, and hinged to the back stretcher, which connects the two uprights. Some axles have two cranks and others only one. One is sufficient. An eye is fitted tightly into the treadle to receive one end of the pitman, and the other end is hooked to fit over the crank. Pressing the foot on the treadle pulls the crank downwards. On lifting the foot the treadle is lifted upwards by

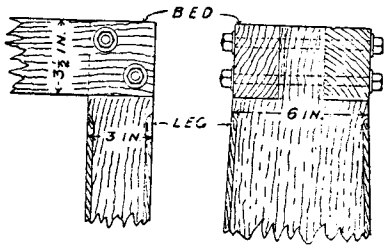


3. Foot-lathe seen from above

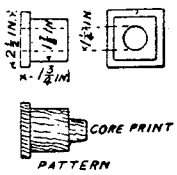


6. Wooden pulley for lathe

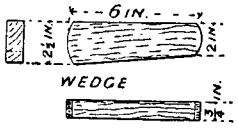




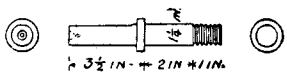
4. Method of jointing leg



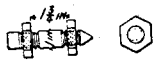
9. Mandrel bearing



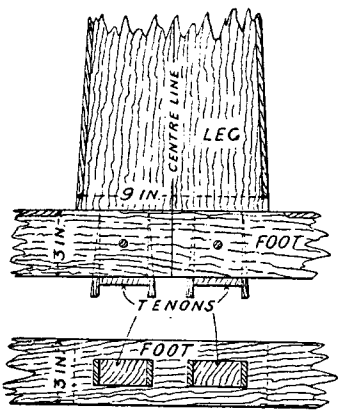
7. Headstock of lathe



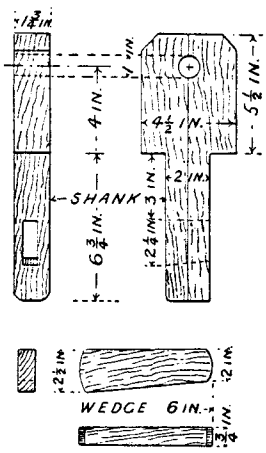
10. Mandrel



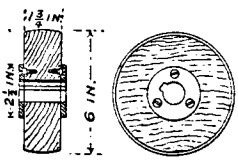
11. Back centre



5. Tenon of leg



8. Headstock of lathe



12. Pulley

the momentum acquired by the heavy wheel. The method of framing the treadle is not by tenons, but by means of half-lapped joints with dovetailed ends, as seen in picture 3. This is rather easier than tenoning. The joints are sawn and planed—using a rebate plane—then glued and screwed. The straps of the hinges cover over the hinder joints where the most severe strain comes. This treadle should be made of hardwood, preferably oak. We can purchase the pitman secondhand for a few cents, or get a smith to forge one. This completes the framing of the lathe, leaving the headstocks and tool-rest still to be done.

On the strong and stiff framing which we have just seen how to make, the actual apparatus for turning has to be fitted. This, as shown in the pictures, is so extremely simple that we should try not to think that it is like the lathes made for sale. It is designed so very simply that most lads may construct it with little assistance. But lathes very much like this may be seen in some of the old wood-turner's shops, and good work is done with them.

We shall begin with the upper fittings on the bed, making references first to pictures 1 and 2. These comprise the fast headstock to the left, the movable poppet to the right, and the tool-rest between. The first drives the work, the second supports the right-hand end of long pieces of work, and the cutting-tool is laid upon the third.

The headstock, seen in picture 1, is built of two pieces of any hardwood—beech, birch, or oak—cut and shaped to the dimensions given. Two uprights, seen in pictures 7 and 8, are shouldered at the bottom to fit between the ways of the bed. The tails or shanks project far enough downwards to allow room for cutting mortises and fitting

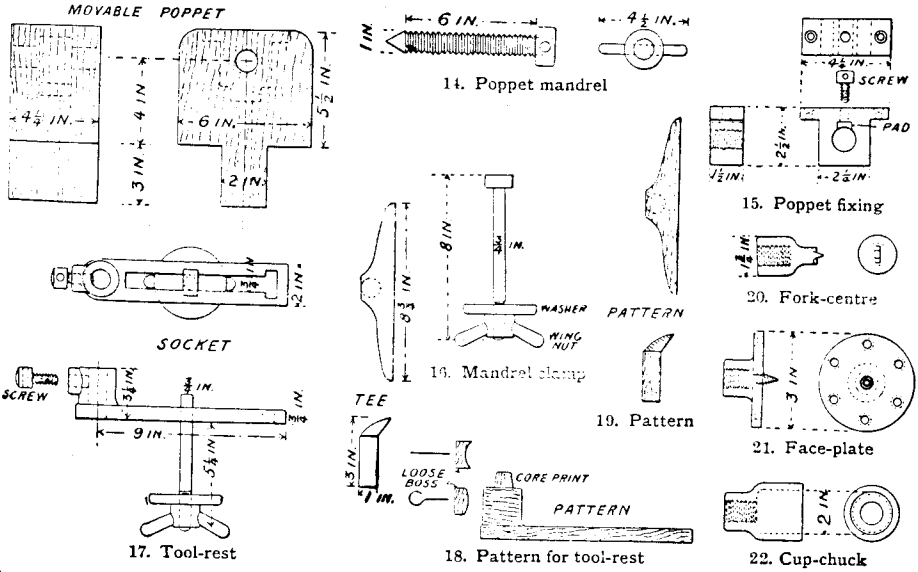
wedges. These, being driven underneath the ways, hold the uprights down securely on the bed. All this is made in any good sound hardwood.

In the vertical centre line of each upright—that is, exactly midway between the ways of the bed, and at a height of 4 inches therefrom—a hole will be made in each piece. The hole in front is square, as may be seen in picture 7, to receive a small brass casting, seen in picture 9, which forms a bearing in which the *mandrel*, seen in picture 10, is to be fitted.

For this casting a pattern has to be made in wood, and cast in brass, with a hole in it formed by the *print*, and bored smoothly. The casting will be fitted neatly into the square hole in the upright seen in picture 7, and driven in with a hammer. In the other upright, shown in picture 8, a 1-inch round hole will be bored with a centre-bit to receive a screw, termed a *back centre*, with two nuts, and one end pointed, as seen in picture 11. This must be of steel, and hardened similarly to the crank axle-centres. The mandrel must be prepared by a metal-turner to the dimensions in picture 10. It is made of steel, and is recessed at the back end to receive the point of the screw just mentioned. It has a collar turned on it which bears against the hinder face of the brass bearing fitted in the front upright.

This will be made clearer by referring to picture 1. At this end also a screw is cut on the outside to receive *chucks* for holding work. If we show this drawing to a metal-turner he will understand it, and make the mandrel like it. To insert the mandrel, the back upright, seen in picture 8, must be removed, the mandrel inserted in its bearing, and the back upright brought into place and wedged. The nuts on the back centre afford means for effecting an exact degree of pressure on the collar, so that the mandrel will run freely without being too loose. The mandrel is driven by means of a belt on a *pulley*, as seen in pictures 1 and 12. This is bored to fit tightly over the mandrel. This fit alone would not prevent it from slipping round, but a key is necessary; and to prevent the key from splitting the wood a plate of iron is fitted into or on each side, and screwed there, and the slots for the key are filed in the plates as well as cut through the wood. A flat portion is filed on the mandrel to prevent the key from slipping round. Being driven in tightly with a hammer, it secures the pulley firmly on the mandrel.

The movable poppet, seen in picture 1, is also an extremely simple affair, being made of a block of hardwood, shown in picture 13. It has to be moved along and tightened at various positions to suit work of different lengths. The work is centred on it, for which a mandrel, shown in picture 14, is provided. The very simplest way to do this is to get a steel screw made, pointed at one end, and having a round or cheese head at the other, through a hole in which a lever is fitted to turn it by. The screw runs in a nut, seen in picture 15, cast from a pattern or filed from a block of brass or iron, which is fitted into a recess cut in the head, shown in picture 13. The centre of the nut must be in the exact centre corresponding with the centre of the mandrel in the fast headstock—namely, in the middle of the bed-cheeks, and 4 inches above them. When the head is fastened down on the bed, the movement of the screw is utilised to effect a secure support to the work, neither too tight nor too loose. It is not a simple nut only, but comprises the nut seen in picture 15 and a clamping screw and *pad* combined. The pad and screw are necessary to pinch the screw mandrel tightly in position when set up to the work. The pad fits the screw as far as it occupies a portion of the nut. It can be cut out of a common nut, and the recess for it filed in the main nut. If the



mandrel-screw were pinched by the end of the screw, it would soon become bruised. The nut is fitted in the head, and secured to it by means of two little flanges, through which wood screws are run into the head.

The movable poppet might be wedged down upon the bed similarly to the headstock. But the constant shifting about to which it is subjected renders another method of clamping desirable, that, namely, of a screw and wing-nut, as shown in picture 16. A common bolt has its head sunk into a recess cut in the block, seen in picture 13, a little way below the nut recess, and its body is passed through a hole bored down the centre and projecting below the bed-cheeks. Over this a washer fits large enough to bridge the cheeks, and a wing-nut below pinches the head down. An ironmonger could supply these parts.

The *tool-rest*, seen in picture 17, must be made of iron, cast from patterns shown in pictures 18 and 19, one for the *socket*, the other for the *tee*, which is the actual rest. We should be able to make the patterns by following the drawings. The pattern in picture 18 in plan is cut like the socket seen to the left, and the boss for the screw is fitted loosely with a wire. Then some metal-worker will fit a screw to the socket for pinching the tee-rest in any required position, and one for holding the foot down to the bed. Three chucks will be required, a fork, a face-plate, and a cup-chuck, all as shown in pictures 20, 21, and 22 respectively. The first is for holding and driving work between centres; the second for large, thin pieces supported by the fast headstock mandrel only; the third for pieces which are neither large nor long, supported as in the last case. These are all screwed on the nose of the mandrel, and interchange. Picture 20 must be made by a metal-turner; 21 and 22 are cast from patterns similar to the castings, and either in brass or iron, but they have to be screwed by a turner, when the chucks can be turned up truly in their places.

The prong, or fork, of the chuck, seen in picture 20, is driven into one end of the piece of wood which it has to rotate, the fork affording the necessary leverage. All work which exceeds a few inches in length is driven thus, the farther end being supported on the mandrel centre of the movable poppet.

One face-plate, picture 21, is shown. The screw in the centre holds very small pieces. Larger pieces must be secured with wood screws put in from the back through the holes.

The bell or cup chuck, seen in picture 22, receives short pieces of work which have to be turned or bored out on the front end. The wood is driven into it with a hammer, and is thus held without any further assistance.

A leather belt ⅝ inch or 1 inch wide will be required to drive the lathe. It can be obtained at a saddler's or leather goods shop.

A POPGUN MADE FROM A QUILL

A QUILL popgun is an amusing little toy that any boy can make without expense. All that is needed is a good quill of fair size that we can make from a goose-feather by pushing out the pith. We cut the quill evenly at each end, and make it about three inches long. Now we take a raw potato, and cut it into slices about a quarter of an inch thick or a little more. We push one end of the quill through one of the slices of potato, and this will cause a piece of potato to stick in one end of the quill. Then we push the other end of the quill through a slice of potato, thereby getting a piece of potato at that end also. Now we make a piece of wood as shown in the picture. This is to act as the rammer. The thin part should be almost the size of the quill, and the thick end is to prevent it from going too far through the quill.

The popgun made from a quill

Then, by pushing this rammer into one end of the quill, we can fire our popgun, which we can load as often as we wish by pushing the empty end into a slice of potato. The quill popgun makes very good amusement.

ANSWERS TO THE PICTURE PUZZLES ON PAGE 4766

ON page 4766 we have a picture of a street scene in which the artist has purposely drawn many things wrongly. The observant reader will notice the following mistakes.

1. The lamp-post should stand on the pavement, and its ladder-arm is on wrong side.
2. The notice of "Keep to the left" should read "Keep to the right," and is on wrong side of the lamp-post.
3. The pavement has no curbstones.
4. The bars of the gutter grating are the wrong way up, and they should also be at right angles instead of parallel to pavement.
5. The cyclist's front forks are wrong.
6. The truck's handles are also the wrong way round.
7. The motor-car has the handle of its door and its taximeter in their wrong positions, and the license number is in its wrong place.
8. One of the window-sashes on the first floor of the middle shop is wrongly placed.
9. The words "To Let" are made to read from the inside instead of the outside, as it should.
10. In the right-hand corner of the picture the end of the hand-rail on each side of the steps curls the wrong way round.

THE NEXT THINGS TO MAKE AND THINGS TO DO BEGIN ON PAGE 4993