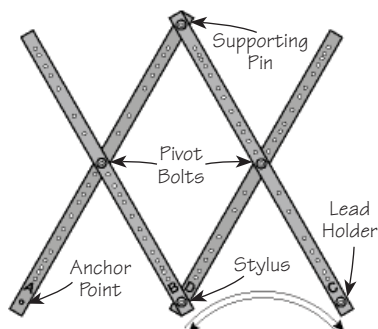


A pantograph is used to change the scale of drawings; this one, with 15" wooden arms, can be used to enlarge any plane figure up to ten times its size, or reduce it to 1/10 of the original.

There are 19 different settings, from $1\frac{1}{9}$ to 10.

It consists of a clamp to anchor it to the working surface, four flat wooden bars, two bolts on which the bars pivot, a supporting pin with rounded end, a pointed stylus for tracing the image, a lead holder, and a container of soft leads.

Before using, ensure that your pantograph is set up, as shown. Two of the flat bars will be on top of the assembly, two on the bottom. When all the bars are assembled, they should form a parallelogram. Bar A should be parallel with bar D, and bar B should be parallel with bar C.



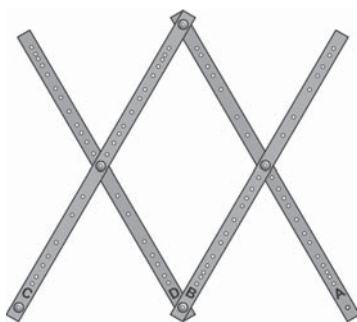
The position of the stylus and lead holder will depend on whether you want to produce a drawing larger or smaller than the original. For an enlargement, set the stylus between the anchor point and the lead holder. For a reduction, switch the position of the lead holder with that of the stylus.

To install a lead in the lead holder, first remove the knurled collet to expose the slotted chuck. Insert a sharpened lead in the top of the holder, pushing it through with another lead or a small finishing nail, then replace the knurled collet.

Set the pantograph to the desired ratio between the original and the copy. For example, if the copy is to be $2\frac{1}{2}$ times the original, set the pivot bolts through the bars at the holes marked $2\frac{1}{2}$. Fasten the nuts on the pivot bolts only finger tight. While there should not be any space between the bars, the nuts should not be so tight as to restrict the movement of the bars.

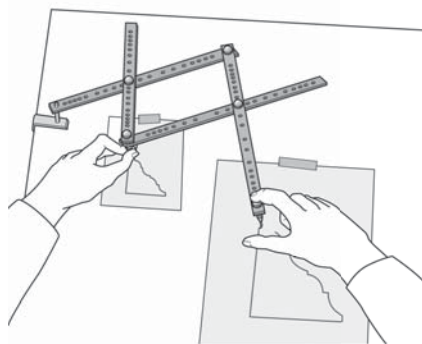
Secure the clamp (to your left if you are right-handed) to the edge of your working surface. If the source of the diagram to be copied is more than 2 mm thick, you will have to shim the clamp and make other height adjustments to bring all working parts to the same level.

Note: If you are left-handed, position the bars as shown at right, and secure the clamp to your right.



Slip the pin projecting from the clamp into the anchor point (the hole under letter A), then open the pantograph to about half its maximum extension. Set the original drawing under the stylus and a scrap piece of blank paper under the lead holder. Tape the papers to the work surface to prevent them shifting as you trace. A test trace will determine if your set-up needs adjustments. Move the stylus across the original drawing, then from top to bottom, to check that there is enough room to maneuver the stylus without it getting too close to the clamp and to make sure that the lead holder not only remains on the scrap piece of paper, but that the new image doesn't overlap the original drawing. When satisfied with the set-up, tape a fresh sheet of paper in place of the scrap paper.

To control the pressure of the lead on the paper, hold the lead holder rather than the stylus as you trace. You can also hold the stylus with one hand and press gently on the lead holder with a finger on your other hand, as shown. To copy long straight lines you need only mark the end points on your copy, then join the marks with a ruler later.



If the ratio you require is not marked on the bars, a little planning and mathematics may be necessary. Suppose, for example, that you wish to enlarge something 9 times its original size. While there are no holes marked 9 on the bars, you can enlarge a drawing 9 times by doing a two-stage enlargement. Set the pivot bolts through the bars at the holes marked 3 and trace the original drawing. Place the enlarged image under the stylus and trace it to obtain an enlargement 9 times the original.

Another example might be to enlarge a $\frac{3}{4}$ " picture to 8", a ratio of $10\frac{2}{3}$. An enlargement of $\frac{4}{3}$ first (which is on the bar as $1\frac{1}{3}$) would get you to a 1" copy, then enlarging that copy by 8 would get to the required size of 8".