



Instructions for Using the Large Ball and Radius Turning Tool

Radius Tool Parts

See Fig. 1 below for a listing of the parts of the large ball and radius turning tool. The main parts of the tool are the outer frame, the inner frame, the handle, the shank, the tool bit, and the tool bit set screw.

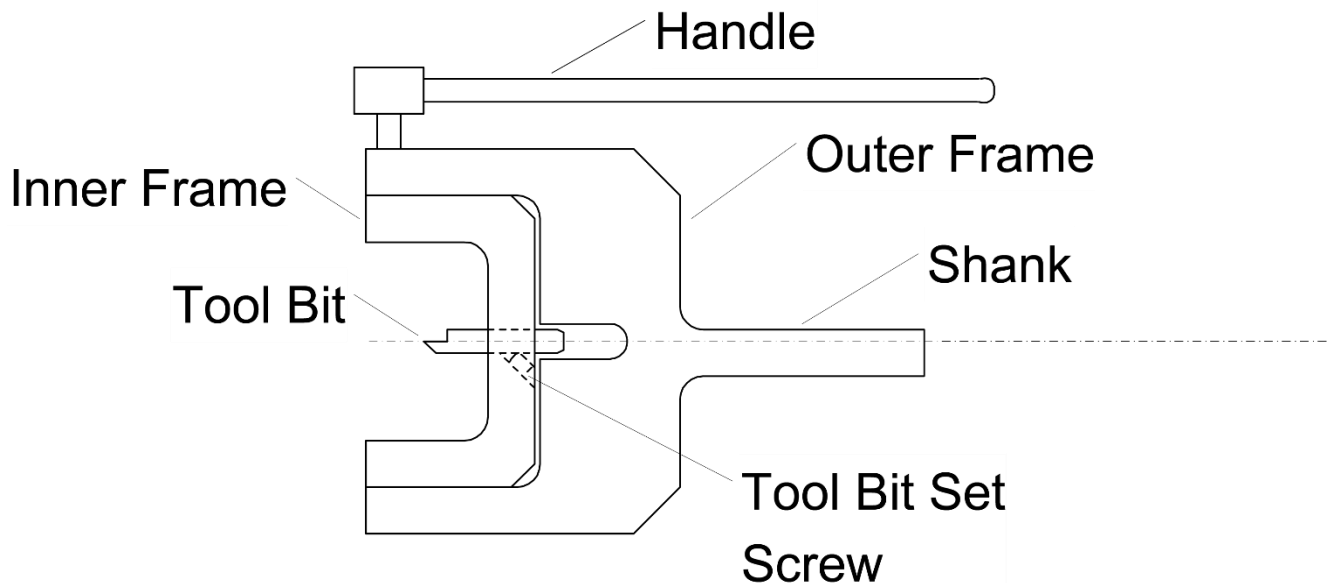


Fig. 1

Using the Tool

The large ball and radius turning tool is designed to cut convex radii (ball shapes) on a variety of materials. Using the tool, you can make ornamental balls on the end of handles, ball joints, governor weights, round contact points for tools, nose cones, and many other useful and decorative objects. The large ball and radius turning tool is sized for small to medium sized lathes, although it can be used with any size of equipment. A lathe swing of at least 5" is required for the tool frame to clear the lathe bed. Although it is versatile, the radius tool is basically a finishing tool, and as such, it is designed to take a large number of light cuts, not a small number of large cuts. However, using the proper techniques, even a large radius on harder materials can be produced quickly and accurately.



Sample Work

These samples were turned with a ball and radius turning tool. The ball at upper left was turned from difficult to machine 2" diameter 1018 cold rolled steel. Although, beyond the stated capacity of the tool, this shows what can be done with good technique and a little patience.

Fig. 2

The ball and radius turning tool is not difficult to use. However, it is worthwhile reviewing the steps necessary to produce good work:

Steps in using the Radius Tool:

1. Machine work blank to proper starting size
2. Set tool bit length for proper radius
3. Set up tool in lathe to center height
4. Turn the inner frame parallel with spindle axis and move tool toward work until tool bit just touches.
5. Move cross feed out and then slowly in until tool bit just touches work when swung through range.
6. Move cross feed in a few thousandths.
7. Make a cut.
8. Repeat 6. and 7. above until the desired radius is achieved.

Machining work blank

To save time, you will want to first machine your work piece to a rough shape approximating the ball or radius shape you are going to cut. Below are examples of rough cuts which are can be made before setting up the radius tool (Fig. 3). These cuts are made with standard lathe tools using the cross and longitudinal feeds.

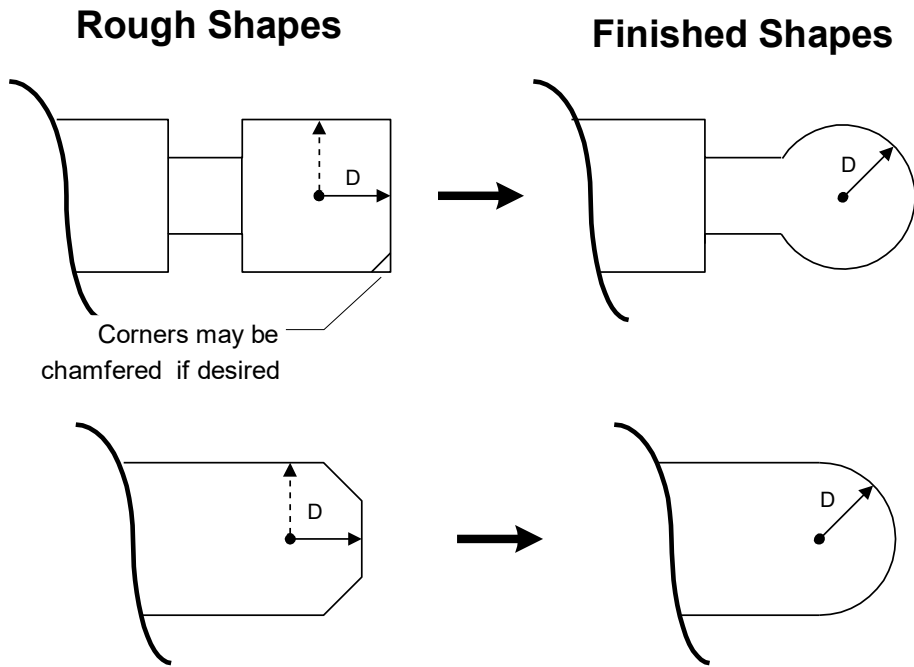
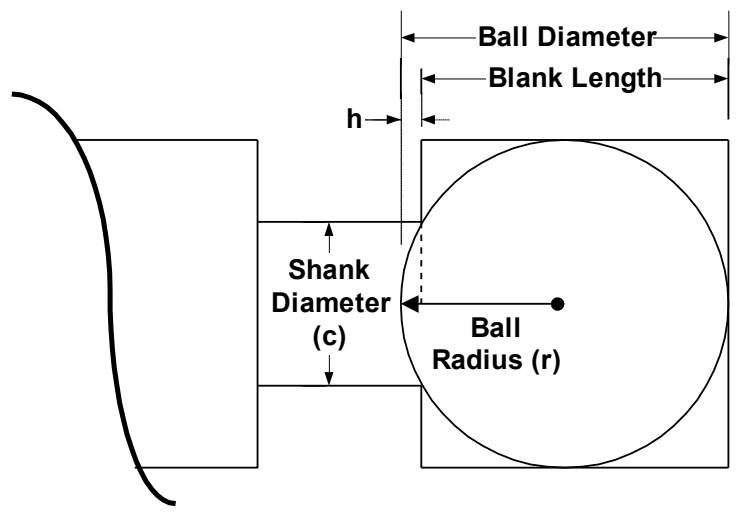


Fig. 3

Be sure to machine your rod down to the diameter of the ball or radius you are going to turn and face the end. If you are turning a ball shape, create a smaller diameter behind the ball as shown above. It is a nice idea, and will save time, to chamfer the edges of the bar as well, thereby "roughing out" the radius.

When machining a blank for a complete ball shape, remember that the length of the square portion of the blank is not twice the radius, but is slightly less, depending on the shank diameter. The exact length of the blank can be calculated from the formula shown in Fig. 4.



Blank Length = Ball Diameter - h

$$h = r - \frac{1}{2}\sqrt{4r^2 - c^2}$$

Fig. 4

Setting Tool Bit to proper radius

The ball and radius turning tool comes with a pre-ground high speed steel tool bit. The tool bit is held in position by a set screw in the inner frame. The distance of the tip of the tool bit to the center line of the rotation of the inner frame is the radius that the tool will cut (Fig. 3).

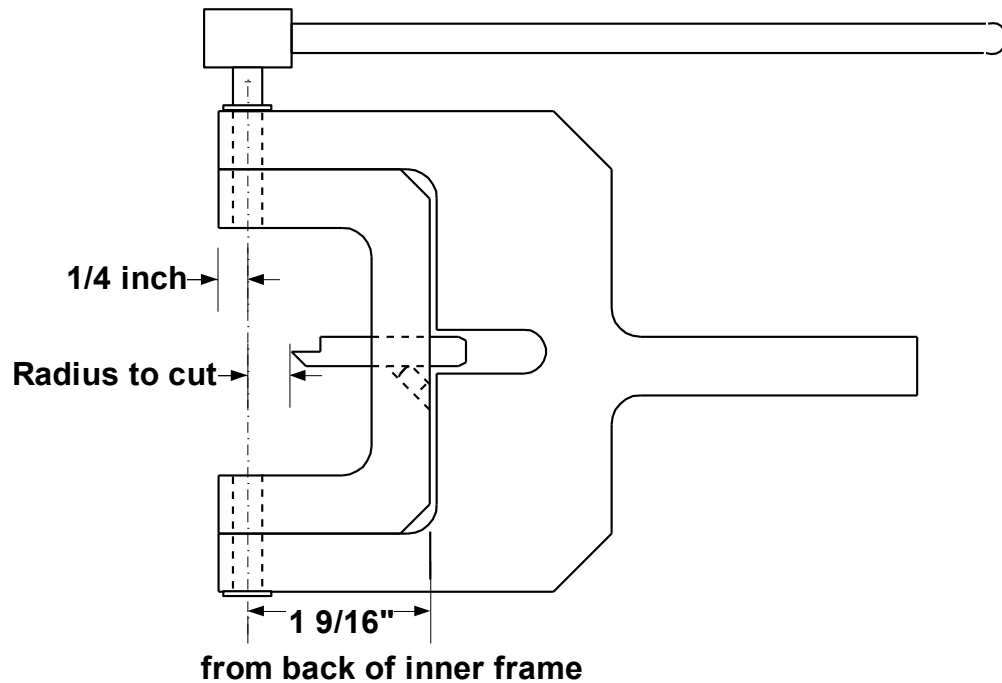


Fig. 5

An easy way to set the tool bit length is to rotate the inner frame 90 degrees, place a straight edge between the two edges of the inner frame (in the photograph, I am using a square lathe tool bit as a straight edge), and measure from this edge to the end of the tool bit with a rule or a depth gauge. Fig. 6 shows this technique being used with the [Small Ball and Radius Tool Part #2569](#).

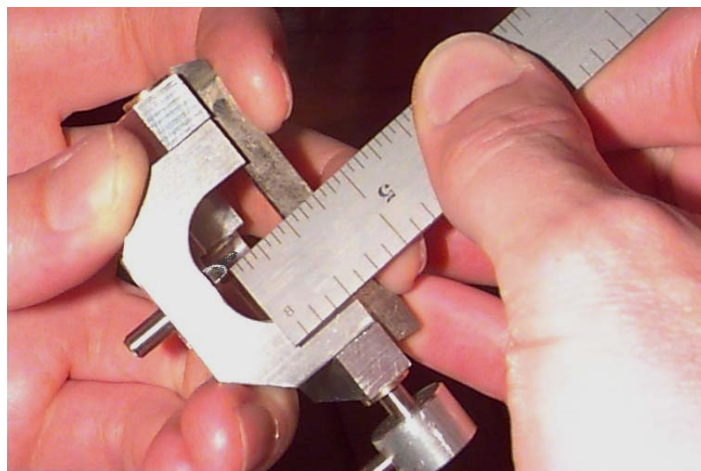


Fig. 6

The center of rotation is 1/4" from the end of the frame, so subtracting 1/4" from your measurement will give you the radius you are going to turn.

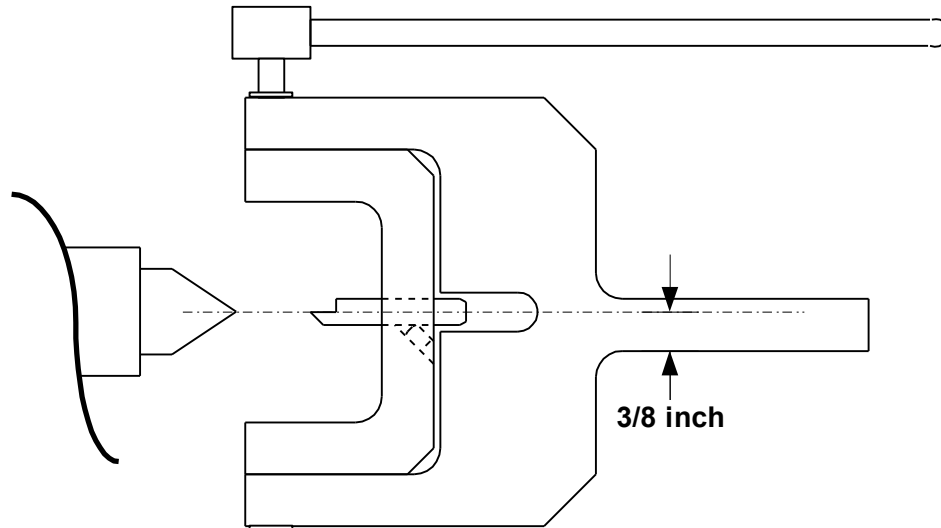
It is a little tricky to tighten the set screw when measuring for the radius length (you run out of hands!). I find the following procedure works well for me:

- a.) Loosen the set screw very slightly so that the tool bit will just stiffly slide in its slot.
- b.) Extend the tool bit a bit closer to the center of rotation than needed.
- c.) Push the tool bit down with the end of the rule (or depth gauge) as you are making the measurement
- d.) Tighten the tool bit set screw.

Another technique that can be used is to measure from the back of the inner frame to the tip of the tool bit. The back of the inner frame is 1 9/16" from the center of rotation, so subtracting your measurement from this value will also give you the radius you are going to turn.

Setting up the tool in the lathe

The ball and radius turning tool is held by its shank in a standard lathe tool bit holder. It is important that the radius tool's tool bit be set close to "on center" in the lathe. The tool is designed so that the tip of the tool bit is 3/8" from the bottom of the shank (Fig. 7). This



means that if your lathe holds a 3/8" tool bit on center, the radius tool will be held on center in the same tool holder. Some lathes may require shims to get the tool bit on center.

The tool is placed in the standard lathe tool holder, with the outer frame is rotated to any convenient angle. Note that the outer frame does not need to be perpendicular to lathe spindle

rotation axis. On most smaller lathes, the outer frame will not fit over the cross slide, so you will need to overhang the tool over the bed.

Make sure that you can swing the inner frame freely in the lathe, and that the tool handle does not hit any part of the lathe. The handle is held by a set screw, and can be rotated to any desired angle (Fig. 8).

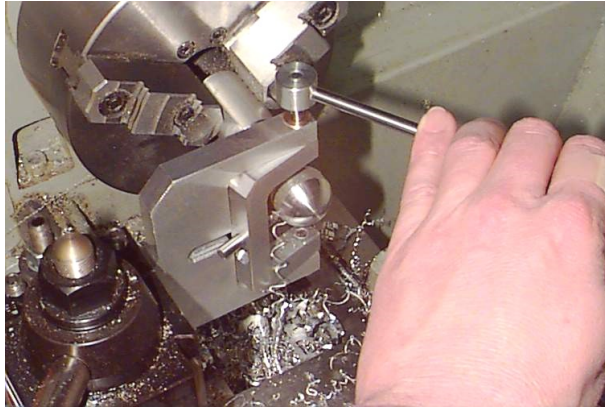


Fig. 8

Starting to Turn a ball or radius

To begin to turn a ball or radius, turn the inner frame of the tool parallel with the spindle axis (Fig. 9). Mount your work in a chuck or collet with as little overhang as possible.

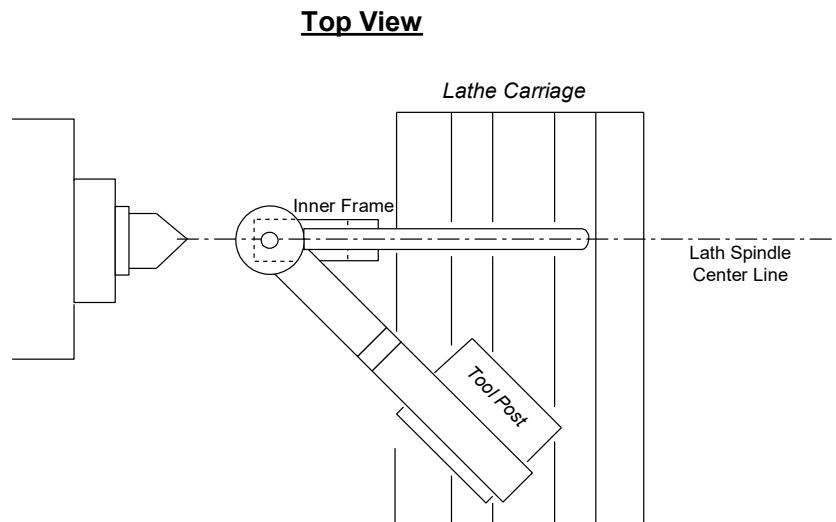


Fig. 9

Now, move the carriage to bring the tool bit just up to the end of the work (Fig. 10). If the work has been pre-machined correctly, this will set the tool bit to the exact end of the ball or radius. Next, without moving the carriage, crank the cross feed all the way out to completely clear the

work. Then bring the cross feed in until you are at the point where when the tool frame is swung through its full range of motion for the cut, the tool bit is just beginning to contact the work.

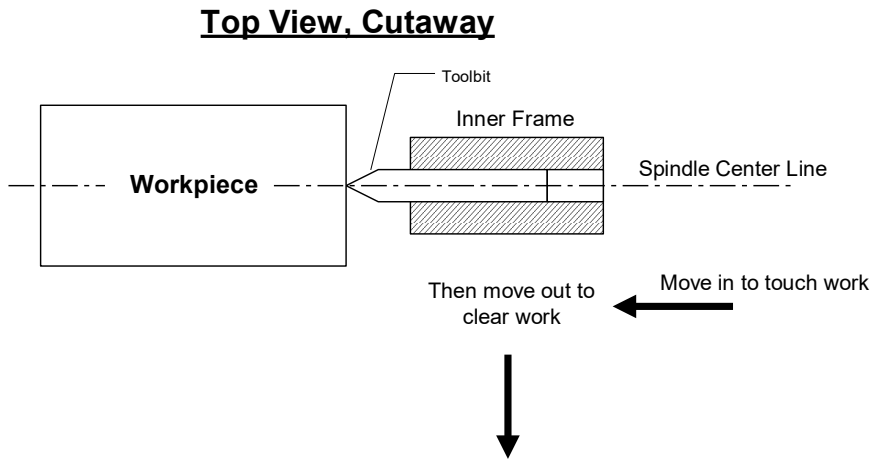


Fig. 10

Set your lathe to the highest speed allowable for the type and size of material you are using. Now, bring the cross feed in a few thousandths, and swing the inner frame to take a cut. Crank the cross feed in a few more thousandths and take another cut. Continue to repeat this pattern. You will find that you can keep one hand on the cross feed handle,

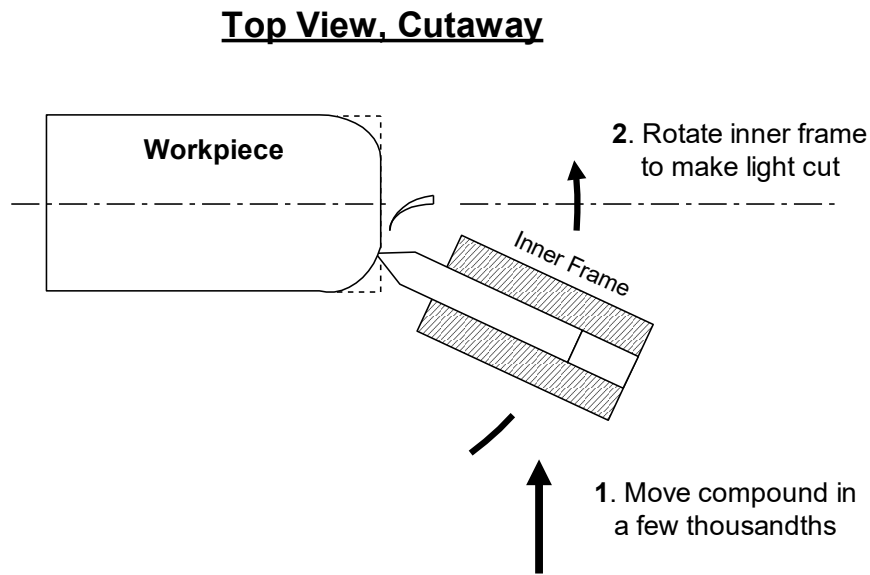


Fig. 11

and one on the tool handle and make these cuts and movements quite rapidly. Remember to take a large number of light cuts, slowly reducing the work down. As you continue, the radius shape will slowly, almost magically, appear. When the tool bit is cutting along its full range, you are finished. It is often useful to make a final finishing pass of 2-3 thousandths turning the tool handle as slowly

as possible and running the lathe at the highest speed possible for the class of work. For a mirror finish, sand the work lightly with fine emery paper and finish with metal polish.

Tool bit grinding

The tool bit supplied with the radius tool may eventually need to be re-sharpened. This can easily be done on a simple bench grinder, or even a hand stone. Approximate grinding angles are show below (Fig. 12), although these are not critical and you may want to modify these somewhat depending on the properties of the material being cut.

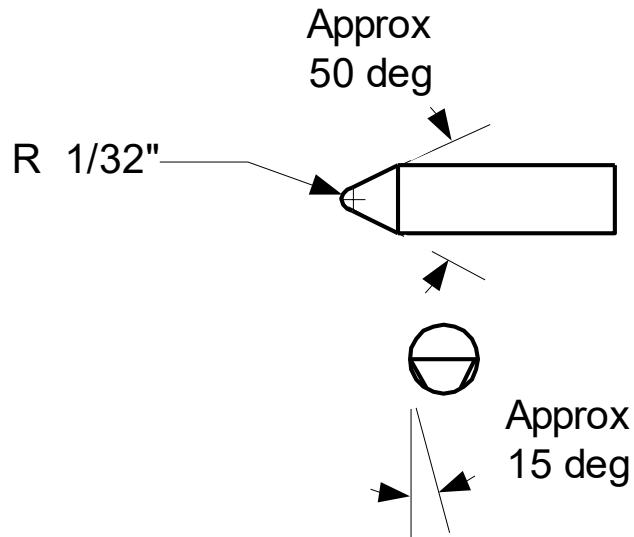


Fig. 12

Care of the Tool

When not in use, the ball and radius turning tool should receive a light coat of oil to prevent corrosion. In addition, occasionally apply a small amount of oil to the rotating pins which hold the inner frame, and the gap between the inner and outer frames.

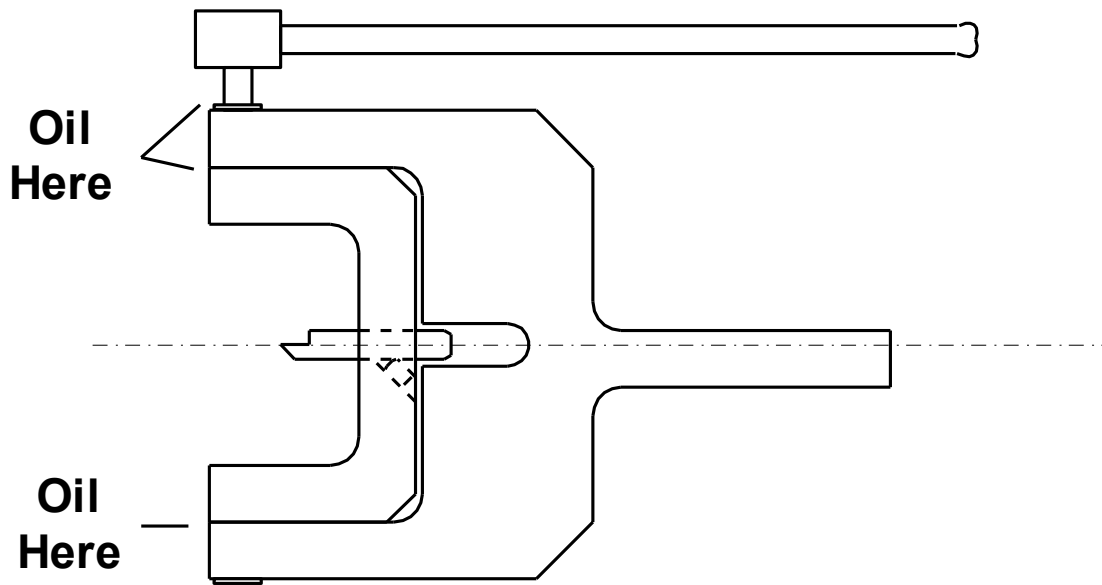


Fig. 13