

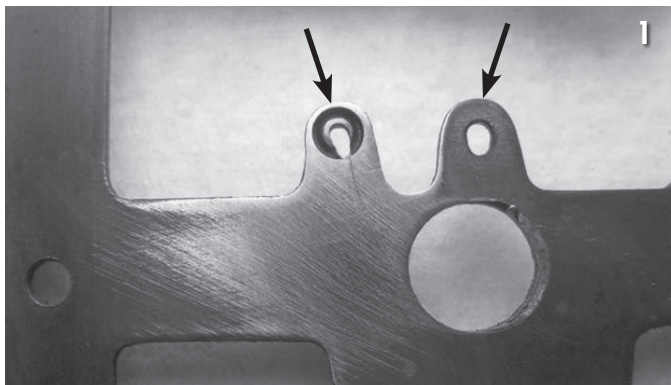
**SHERLINE
PRODUCTS**
INCORPORATED 1974

Horological Milling Machine Bushing and Depthing Accessory

P/N 2118

Overview

When a non-jeweled clock or watch arbor pivot rotates for many years, it will, in many cases, wear a path in the movement plate in the direction of force. This can be readily seen in photo #1.



When this happens, the pinions and wheel teeth no longer properly mesh without adding friction, which, in turn, prevents the movement from functioning properly. To correct this, a hole is reamed in the original location and a bushing is installed in that location, returning the hole to its original size and position.

While not the only ones, there are two major companies that supply bushings and matching reamers: KWM and Bergeon.

When starting out, most repair people will use a hand set of either KWM or Bergeon reamers and matching bushing assortment. When using hand methods, the common suggested method is to first file an equal length path opposite side of the wear. This is done in hope that the reamer will center itself in the original location by following the path of least resistance.

Some days you're lucky, some days you're not. This method gets old fast if any number of bushings are done.

The next method would be to use a "drill press bushing tool adapter" and mount it on a drill press.

In this case the reamer is spun too fast risking damage. In addition, the cheap chucks with excessive runout enlarge the reamed holes, decreasing friction fit to the point that bushings can come out during operation and, of course, cause great damage in some cases.

From this point, active repair people generally move up to

a bushing machine. While they do have some issues, they do a respectable job in a timely fashion. However, they are limited to bushing only and only for clock movements. The Sherline mill offers more precise bushing installation for both clocks and watches as well as depthing in the same timely fashion for about the same cost of a bushing machine. Current bushing machine prices range from about \$800 up to \$1,200.

In addition, a milling machine offers added capabilities for any repair as well as the construction of a movement from bar stock.

What Is Needed to Bush on a Sherline Mill

1. We recommend a 5000 mill with a headstock spacer or 5400 mill. The spacer is required to fit plates up to 7" wide that cover most commonly encountered movements. A second spacer could be added if ever required.

NOTE: We recommend using our 5400 mill over our 2000 mill for bushing, because the 5400 model has a fixed column and it is less likely to move when you use the headstock as a bushing press.

Customers purchasing a mill for bushing should first read the instruction and assembly guide to become familiar with the operations of the mill.

2. A Horological Bushing and Depthing Block set.
3. Reamers and matching bushings of customer's choice.

Bushing Setup on the Sherline Mill

1. Install the movement plate in the bushing blocks (P/N 21180) and mount on the mill as in photo #2 and diagram #2.

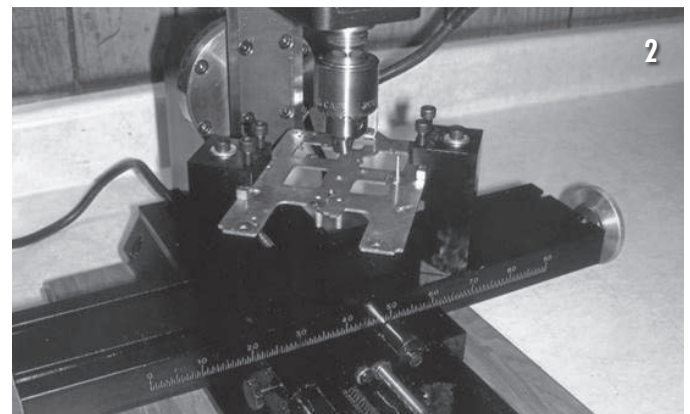
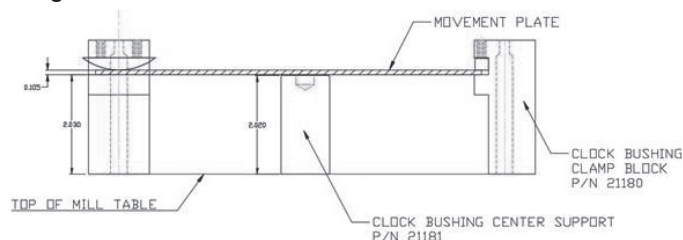
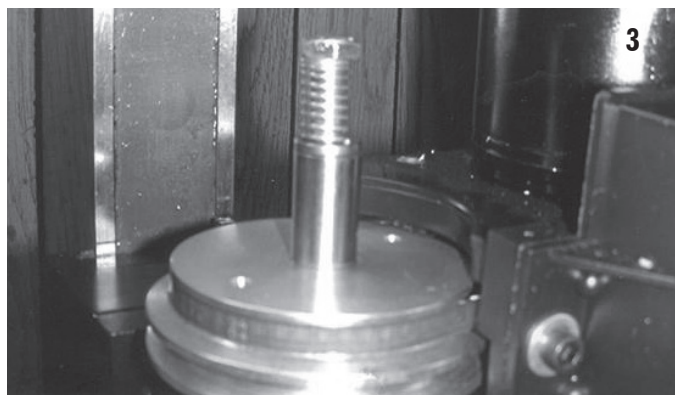


Diagram 2

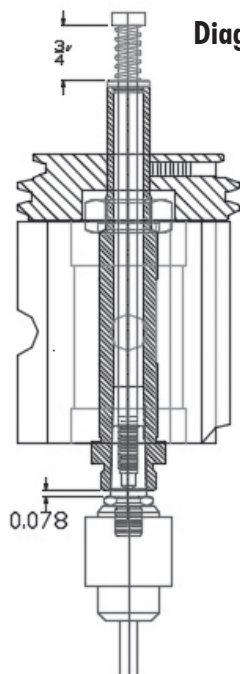


2. Place the Clock Arbor Press "Center Support" (P/N 21181) under the movement plate so it is near the pivot hole into which you are going to insert the bushing. This will give adequate support to your movement plate during your machining operation without getting in the way.
3. Then tighten the clamping screws on the bushing blocks to secure the movement plate in place.
4. Install the drill chuck with a 6" bolt and spring as shown in photo #3.



5. Screw the drawbolt down until the gap between the top of the drawbolt washer and the head of the bolt is approximately $\frac{3}{4}$ " (10 to 11 turns). (see diagram 3)

Diagram 3

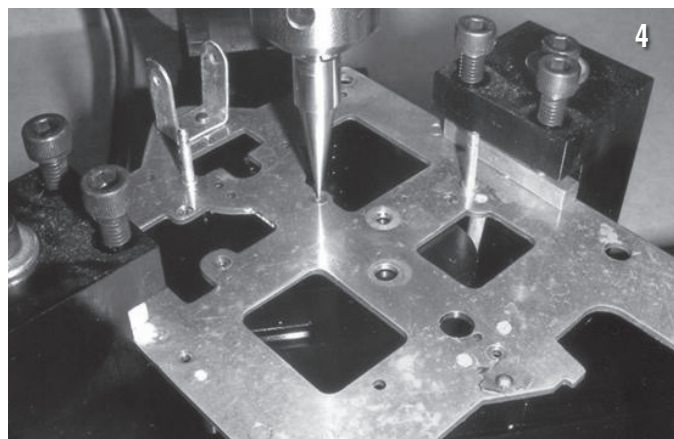


NOTE: This method of securing the chuck arbor into the spindle is NOT recommended for any heavy cuts. If you are going to do any milling or heavy machining, use a mill collet to hold your end mill, not the drill chuck.

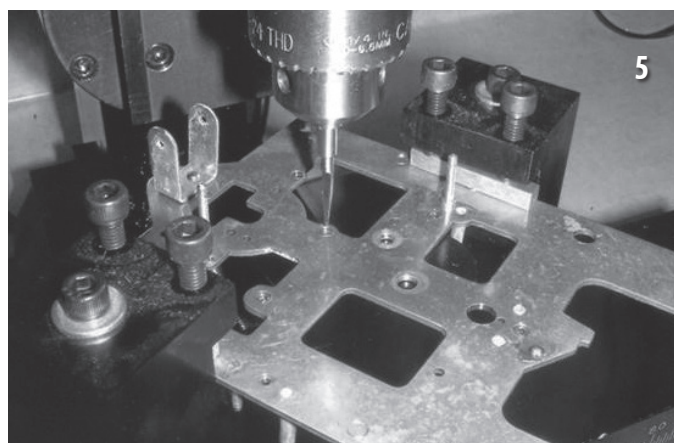
Accurately Locating the Original Pivot Hole

In most cases the original pivot location is obvious per photo #1 being the largest radius.

1. Manufacturers of reamers can supply location cones as seen in photo #4.

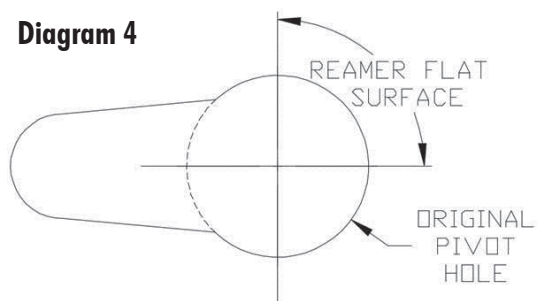


2. The point is used to position the spindle center to the original pivot hole under magnification if needed. This is done using the "X" and "Y" axis handwheel slide movement.
3. Once one becomes comfortable reaming for bushings, location using the tip of the reamer is possible with practice as shown in photo #5.

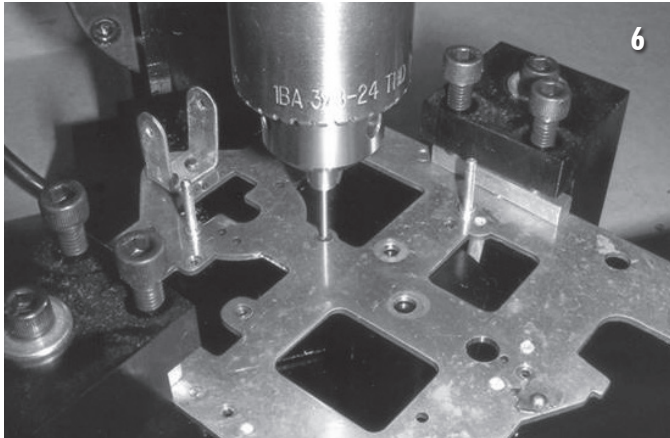


4. Since the reamer is half round, the flat surface is aligned over the center of the original pivot hole using two settings 90 degrees apart per diagram #4. Magnification would be encouraged for this operation.

Diagram 4



- The most accurate location method is to use a pin the same diameter as the pivot and position it in the original pivot hole location as shown in photo #6.

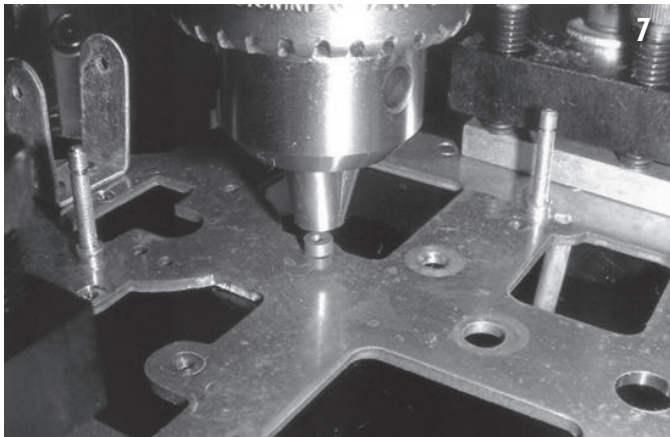


- Pins can be drill shanks, gage pins or machined tips on a work piece. Magnification is a must for this operation.

Reaming and Installing Bushings

In most cases the original pivot location is obvious per photo #1 being the largest radius.

- Once the spindle is set over the original pivot hole location, the reamer can be installed (see photo #5), and the hole reamed at the SLOWEST SPEED POSSIBLE.
- At this point the reamer is removed from the chuck and the chuck is spun closed. A bushing is set over the hole with the oil sink to the outside of the plate as shown in photo #7.

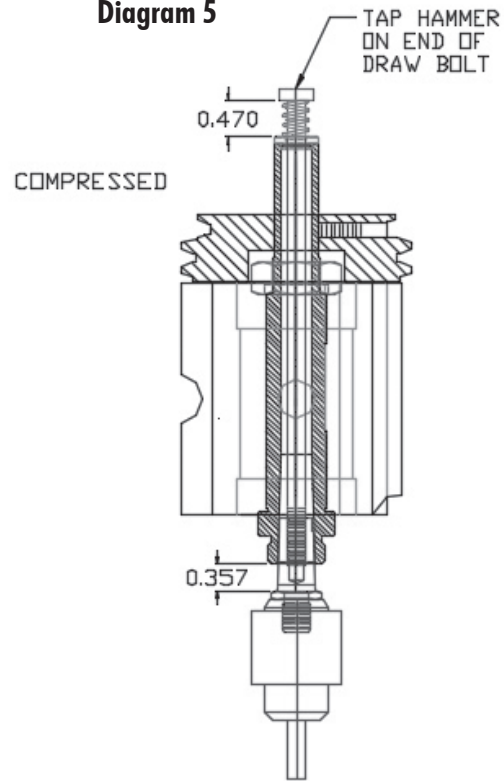


- The tip of the chuck is then lowered down to the top of the bushing and a small hammer is used to tap the bushing in place. With the bushing center support under the movement plate, tap the top of the chuck mounting bolt as shown in photo #3 (see previous page).

NOTE: The bushing center support (P/N 21181) must be in place directly beneath the bushing with the at side facing up. This will ensure that the bushing surface is flush with the movement plate and that the movement plate does not bend while the bushing is being pressed in.

- With the drawbolt threaded in 10 or 11 turns to the $\frac{3}{4}$ " dimension, the amount of throw that the chuck and arbor have is approximately .300" (see diagram #5).

Diagram 5



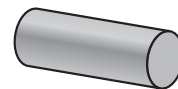
High Precision and Watch Bushing

For high precision bushings we recommend using a WW collet adapter and collet draw bar (P/N 1161), and WW collets to hold tooling in place of the drill chuck. KWM reamers require a $\frac{5}{32}$ " (P/N 116010) or #40 WW collet (P/N 117840). The Bergeon requires a #50 WW collet.

For clock bushings, an 8"-9" long 6mm rod can be inserted down the center of the drawbar and tapped with a hammer to seat a bushing when using this arrangement. You can purchase the accessories mentioned above if you choose to use this method. 6mm Drill Rod can be purchased from several suppliers. The vendor below is McMaster Carr. This example is from 11/17/2014 and the part numbers and prices may vary.

Multipurpose O1 Tool Steel

Metric Tight-Tolerance Rods—Precision Ground



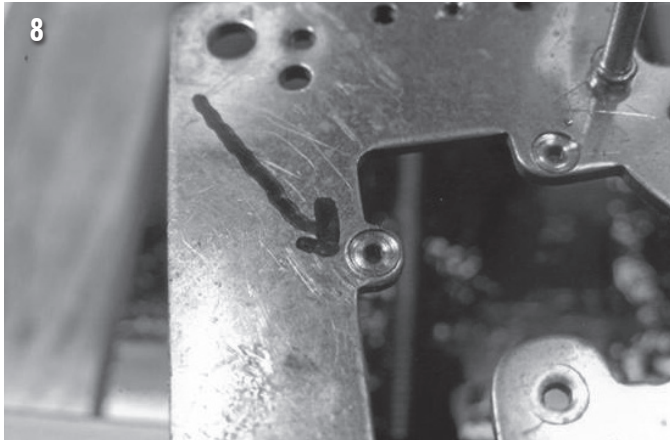
- Meet ASTM A681

These rods are annealed.
Also known as drill rods.

3 ft.			
Dia., mm	Dia. Tolerance, mm		Each
2	±0.013	88625K61	\$2.49
3	±0.013	88625K62	2.76
4	±0.013	88625K63	3.05
5	±0.013	88625K64	3.62
6	±0.013	88625K65	4.47
7	±0.013	88625K66	4.79
8	±0.013	88625K67	5.70
9	±0.013	88625K68	6.81
10	±0.013	88625K69	7.79

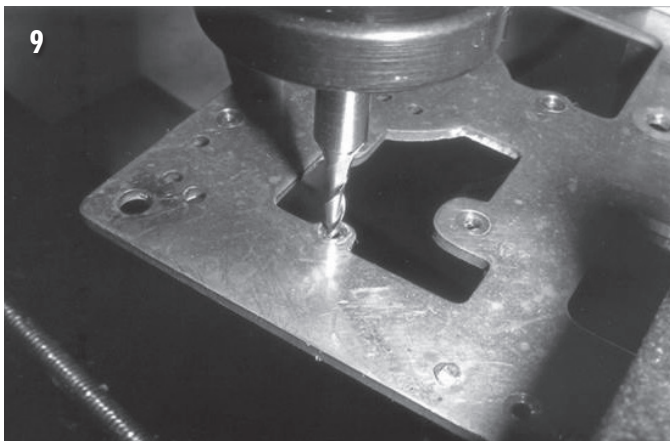
The Added Benefit of Using a Mill for Your Bushing and Depthing

From time to time one will encounter pivot holes that are very close to the edge of the movement plate as shown in photo #8.



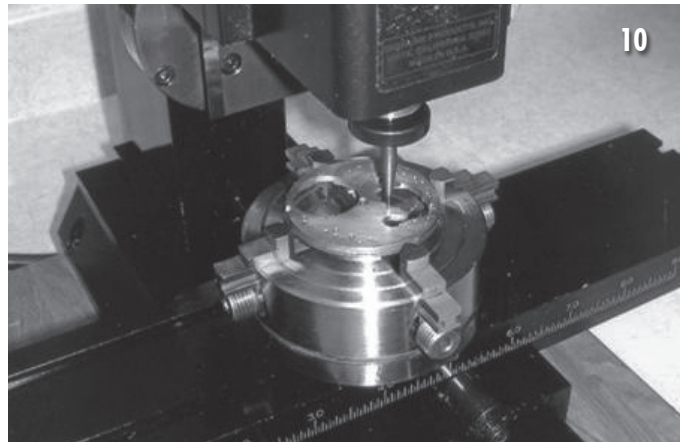
One of the issues with tapered reamers in this situation is that as they ream a hole, they create an outward cutting force. Occasionally this outward force can break through the outer edge of the plate causing all kinds of headaches and issues.

The use of a milling machine will allow one to machine a bushing hole using end mills sized for a specific application as shown in photo #9.

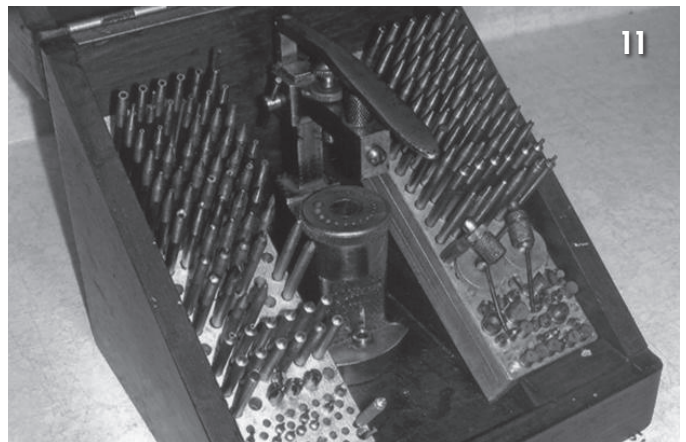


Since end mills do not cause an outward cutting force, they are very safe for this type of situation. This allows a hole to either be sleeved or bushed as desired. While this will require that a person machine a special diameter bushing, it is much faster and simpler than the alternative. While only one example, the mill allows one to resolve any issue that may come up in horological repair when familiar with its operation.

Occasionally there is a need to bush non-jeweled areas in watch movements or clock platform escapements. It may be in an inexpensive watch with sentimental value or an early valuable fusee. In whatever case, the mill has the capability and accuracy to handle this type of work when utilizing WW collets as shown in photo #10.

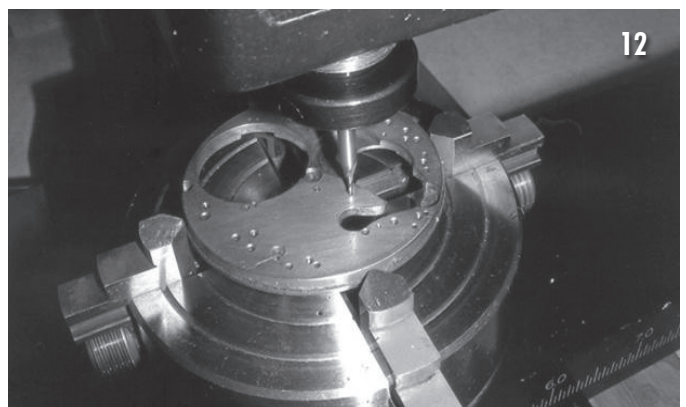


In photo #10 a watch movement plate can be seen mounted in a four-jaw chuck attached to the mill bed. Micro bushings of this type are identical to the clock examples above with the exception of micro tooling. When working on watches it's a necessity to have a watchmaker's staking set as shown in photo #11.

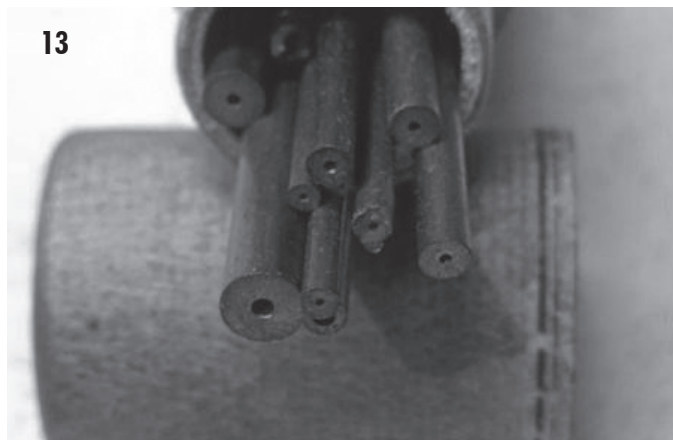


When doing micro work it is critical to see what one is doing. In this case a small centering pin can be inserted in the end of a staking set stake that in turn is mounted in the spindle as shown in photo #10.

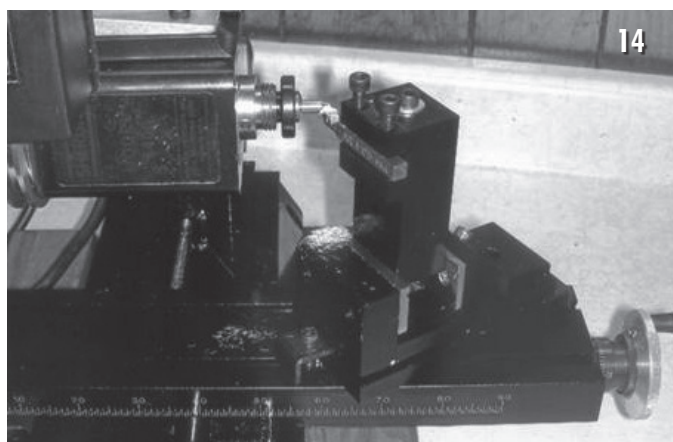
This allows the small diameter pin to be mounted far enough from the end of the spindle so work can be observed. Just make sure everything runs true before use. Since no reamers are currently manufactured small enough for micro bushing, end mills are used to machine accurately positioned bushing holes as shown in photo #12.



In use, one must normally machine their own bushings from bar stock or bushing wire as shown in photo #13.



If one has ordered a mill for bushing work and has no lathe, the mill can be used as a lathe until a lathe is purchased. To do this, first setup the mill as shown in photo #14.



With a bushing block mounted in the mill vise. This will allow you to machine bushings and other small parts utilizing lathe tools as shown in photo #15.

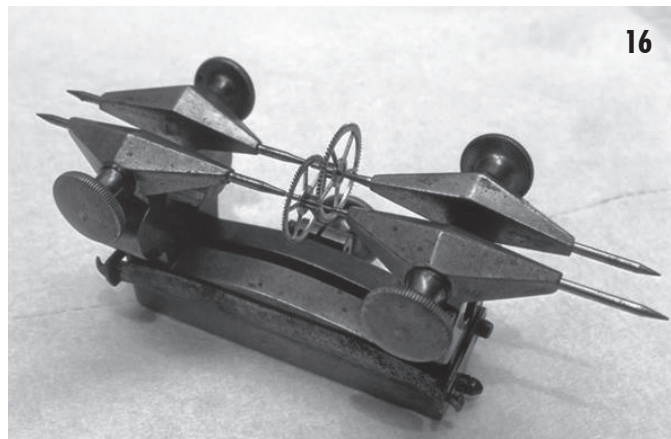


Micro bushing can be pressed in place using a staking punch mounted in the spindle and "Z" axis handwheel to move the headstock. However if need be, the 6mm rod can be inserted in the drawbar and lightly tapped with a small hammer that, in turn, will drive the staking stake.

Depthing

From time to time, repair people will install a bushing in the wrong location, causing friction that will not allow the movement to run properly. On rare occasions they can even come from the factory this way. At any rate, it is not the way one would like to start out the day, since all traces of the original pivot hole location are lost. The typical suggested method of correcting this is as follow:

1. Remove the old bushing and replace it with a blank bushing.
2. Install the problem arbor and the next arbor in a depthing tool. See photo #16.

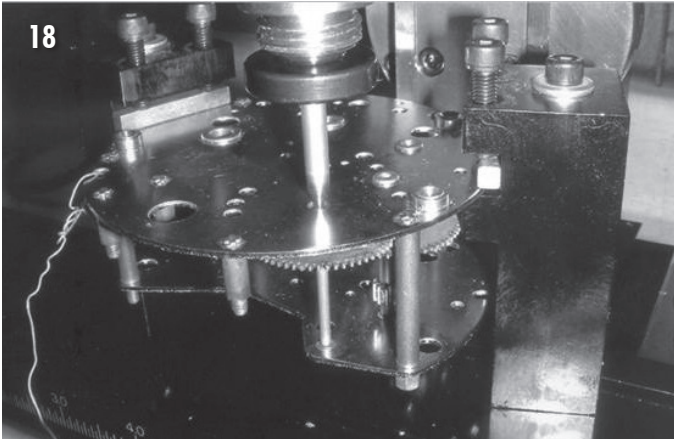


It can be adjusted so that the two wheels run free. Assuming that the two points in front of the wheels are accurately spaced, they can be used to mark the right spacing. See photo #17.



Once complete, the problem arbor and the preceding arbor are installed in the depthing tool and the plate is marked with the second location mark. If the marks are correct and the hole is accurately marked/drilled you will be in business. While a watch size depthing tool is shown, clock sizes are currently going for about \$500 when available. However if you are using the mill and movement blocks, this is a simple fast repair.

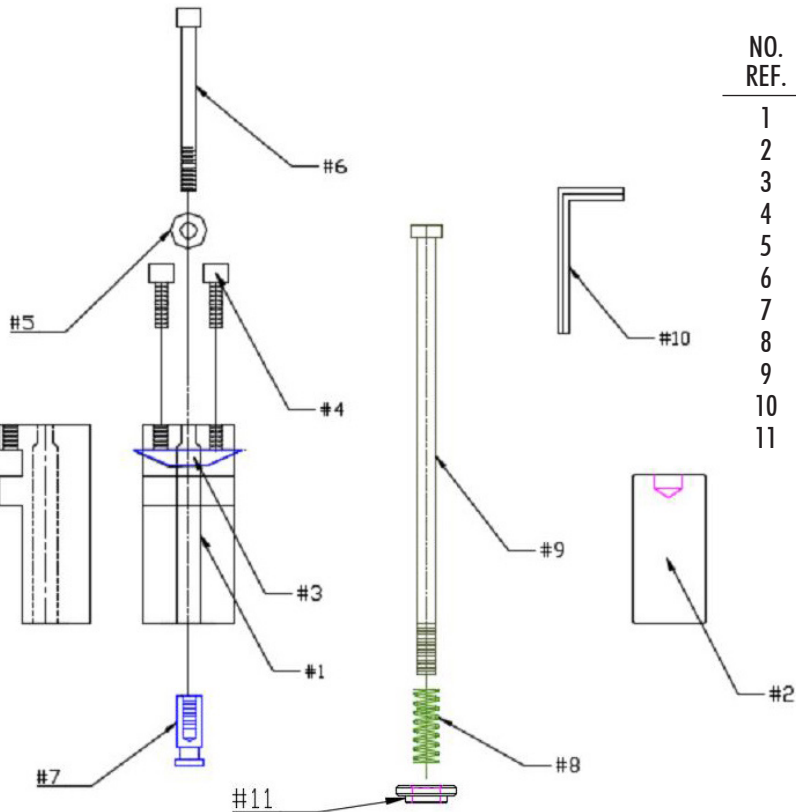
1. Remove the old bushing.
2. Assemble the problem arbor and next arbor between the movement plates and mount on the mill as shown in photo #18.



From this point use a staking punch, machined bushing wire or machined bar stock with a centered hole in the end the same size as the pivot to engage the pivot through the old bushing hole.

This will allow you to position the pivot using the “X” and “Y” axis until the two arbors drive each other with the least amount of friction.

With the spindle correctly positioned, the bushing blocks allow you to drop the bottom plate so you can ream the poorly placed hole with the next larger bushing reamer. Once bushed with the larger bushing, the job is complete with proper depthing.



Parts List			
NO. REF.	PART NO.	NO. REQ.	DESCRIPTION
1	21180	2	Horological Bushing and Depthing Blocks
2	21181	1	Horological Bushing Center Support
3	11990	2	Rocker Tool Post Centers (as clamp pieces)
4	40330	4	10-32 X 5/8" SHC Screw
5	40660	2	10 Washers
6	1286	2	10-32 X 2-1/4" SHC Screw
7	40250	2	Extended T-Nuts
8	21183	1	Spring, 1" Long
9	21184	1	1/4-20 X 6" Hex Head Bolt
10	40550	1	5/32" Allen Hex Wrench
11	3088B	1	1/4" Draw Bolt Washer